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Prototype development and redesign: a case study

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PROTOTYPE DEVELOPMENT AND REDESIGN:
A CASE STUDY

by

Joyce L. Powell

March 1990

Thesis Advisor: Nancy C. Roberts

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Prototype Development and Redesign: A Case Study

by

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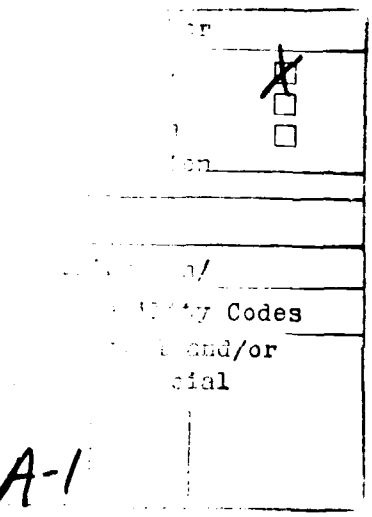

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ABSTRACT

This thesis attempts to document the events, environment, decisions, and personnel involved in the development, implementation and life cycle management of a computer software application. The computer application is developed using a prototyping methodology and a third generation software language for a Department of the Navy Headquarters Command.

The data are presented in a case study format and are analyzed in accordance with software life cycle development principles and change management principles. The case methodology was considered the most applicable tool to showcase the complexity of decisions and processes of computer systems management. The case studies demonstrate the importance of adhering to proven software development principles throughout the life cycle management of a computer application.

TABLE OF CONTENTS

I. INTRODUCTION

A. GENERAL DESCRIPTION

This thesis is an effort to document the events, environment and personnel involved in the development, implementation and life cycle management of a computer software application. Also documented is the maturation process of the organization responsible for the computer application. The data are presented in the format of six case studies which cover a period of two years, and are analyzed in accordance with software development life cycle management principles and change management principles.

B. METHODOLOGY

A case study is a description of a real situation that occurred in a real organization [Ref. 1:p. 108]. Data pertaining to the industry, environment, organization, product, and personnel involved in the situation are presented. The focus or purpose of a case study is on one or several key issues, decisions, or problems requiring a solution. The focus of this case study is on decisions pertaining to development of computer software and the consequences of these decisions on the software and the cognizant organizations over a period of time. A case study is an effective method for presenting valuable insight into the constant technological change and innovation

characteristics of the computer systems management field and their effects on management and organizational change [Ref. 2:p. 370].

The data within a case study are presented not just from one person's point of view, but rather by taking into account as many different views on a situation as possible. Data are presented in chronological sequence and interwoven into a narrative format. The narrative format facilitates the search for facts, questions, and probable explanations for the situation presente by the case.

The data, covering two years of the life cycle of the computer application, we: voluminous. Sources utilized were written documentation, interview and direct observation. Presentation of the data in a chronological sequence was the only way to do justice to the rich description of all the factors which played a part in the decisions, personnel actions, and the environment of the computer application. This methodology also allows for presentation of the entire range of details and processes surrounding a situation.

C. BACKGROUND

The computer application documented is the Officer Assignment Information System (OAIS). This application is used by Naval Military Personnel Command (NMPC) for assignment of Naval Officers. The purpose of OAIS is as a tool to facilitate and improve the officer assignment

process. OAIS is a menu-driven, online, real-time application run on an IBM 4381 mainframe computer. Each user has a remote display terminal and keyboard connected via a local area network to a mainframe. Personnel information, activity billets and automatic orderwriting is provided. A batch mode is used for system maintenance, updating of files and production of large reports.

Development of OAIS took place in the early 1980's. A prototyping development methodology and a third generation software language were chosen for developing OAIS. At this time, prototyping was on the leading edge of technology. By using prototyping, NMPC hoped that problems concerning cost overruns, schedule delays, and applications not meeting user requirements, problems which characterized the current state of the software development industry, would be avoided.

D. RESEARCH QUESTIONS

Two items are of particular interest in this thesis. The first question addresses what could have been done to alleviate, or prevent, problems encountered with OAIS implementation efforts. The second question addresses explanations for problems encountered in OAIS implementation efforts. The information systems department at NMPC is currently preparing for a redesign of OAIS into a database system. The command is interested in identification of any lessons learned from prior OAIS implementations and any possible problems that can be anticipated. Of particular

concern for NMPC is identification of any long-term effects resulting from implementation of the prototype.

E. ORGANIZATION OF THESIS

Following this introductory chapter, the thesis is organized into four chapters and two appendixes. Chapter II describes the case methodology, its advantages and relevance as both a research and teaching strategy. Chapter III contains the six case studies documenting the development, implementation and life cycle management of OAIS. Chapter IV is an analysis of each case study within the case series. The analysis is focussed on software development life cycle principles and management of change. Chapter V contains responses, conclusions, and recommendations in accordance with the stated research questions. Appendix A contains a description of OAIS software interfaces with other computer applications. Appendix B contains timelines and lists of personnel. The timelines document significant events during OAIS development and implementation. This documentation can be of assistance to both case study students and instructors, enabling them to follow the flow of events and personnel over time.

II. CASE METHODOLOGY

A. INTRODUCTION

This chapter addresses the case methodology. The advantages and drawbacks of a case study in comparison with other research methods are discussed. The use and benefits of a case study for both research and teaching purposes also are explored.

B. CASE STUDY FOR RESEARCH PURPOSES

A definition of a case study for research purposes is as follows:

> A case study is an empirical inquiry that
> - investigates a contemporary phenomenon within its real life context; when
> - the boundaries between phenomenon and context are not clearly evident; and
> - multiple sources of evidence are used. [Ref. 3:p. 23]

In this definition, case study research stands on its own as a research strategy. Prior to this definition, a common misconception held by those uneducated in case methodology was that research strategies were of a hierarchial nature [Ref. 3:p. 15]. Case studies were considered as being at the bottom part of the hierarchy. Their use was for the most part a preliminary to other types of research. Consequently, case study usage was primarily limited to the exploratory stage of research. Also case

studies were viewed as consisting of only one small part of the above definition, that of investigating a contemporary phenomenon within its real life context. This is evident when case studies are just used to analyze decisions, processes or events. [Ref. 3:p. 23]

Views on conducting research have evolved to a point that each different type of research strategy is viewed as "a different way of collecting and analyzing empirical evidence." [Ref. 3:p. 15] These views have evolved from the narrow niche given to case studies and the wide, prescriptive view given to experiments. Recognition of the best type of research strategy is now based on subject matter and research purposes. Researchers in a "traditional" sense, where emphasis is on quantitative, controlled events and results that are generalizable and replicable have recognized the benefits derivable from case research. Each type of research strategy can be used for each of the three different purposes of research; exploratory, descriptive or explanatory. Which strategy is used depends on the following three conditions: (1) type of research question; (2) extent of control over behavioral events; (3) focus on contemporary or historical events [Ref. 3:p. 16].

The five recognized research strategies within the social sciences are experiment, survey, archival analysis, history and case study. Experiments, history and case

studies are research strategies that apply to a "how" or "why" type of research question. Experiments focus on contemporary phenomena, but require control over behavioral events. History does not focus on contemporary phenomena and also does not require control over behavioral events. As previously defined, a case study focuses on contemporary phenomena in which there is no control over behavioral events. The only difference between history and case study research strategies, besides the focus of the research, past versus present, is that case study researchers have an advantage of adding direct observation and interviews to their research methodology. [Ref. 3:p. 19]

C. ADVANTAGES OF CASE STUDIES

"As a research endeavor, the case study contributes uniquely to our knowledge of individual, organizational, social and political phenomena." [Ref. 3:p. 14] New situations, interactions and problems occur every day. Case studies provide for a description of "holistic and meaningful characteristics of such real life events as individual life cycles, organization and managerial processes, neighborhood change, international relations, and maturation of industries." [Ref. 3:p. 14]

A unique strength of case study research is its ability to utilize multiple sources of evidence in presenting data [Ref. 3:p. 20]. Such evidence includes documents, artifacts, interviews and observations. This characteristic

enables presentation of data from all points of view and perception. Rarely does one view of a situation contain all the pertinent facts contributing to a situation. By having access to multiple sources of evidence, the full story or explanation is easier to piece together. Case study research allows a showcasing of cause and effect factors of a situation or problem. With the active observation of a case study researcher, many details are provided in addition to available written documentation. This facilitates an ability to document the possible causes and effects in a relationship.

Another advantage to the case study method can be found in the use of qualitative data. Qualitative data is in the form of words, not the numbers traditionally relied on. Qualitative data does have some advantages over quantitative data. Qualitative data are a "source of well-grounded, rich descriptions and explanations of processes occurring in local contexts." [Ref. 4:p. 15] Words gleamed from interviews, observations and documentation can indicate people's attitudes, internal relations among personnel and relative power and influence within an organization [Ref. 5:p. 49]. Words possess a quality of "undeniability" about them [Ref. 4:p. 15]. "Words, organized into incidents/ stories provide a concrete, vivid, meaningful flavor that often proves far more convincing to a reader...than a page of numbers." [Ref. 4:p. 15]

D. DISADVANTAGES OF CASE STUDIES

A major difficulty contributing to acceptance of the case study as a significant research strategy is that the data gathered and analyzed are qualitative in nature. "Numbers don't lie" is a popular cliche in support of quantitative data. This negative viewpoint is based primarily on two factors. One factor is that words can have a variety of meanings. The interpretation given to them by the researcher is viewed as a possibility for bias. The numbers faction prefers experiments where there is control over events and the results, in the form of numbers, are interpreted the same by all analysts. There can be no bias in the interpretation of numbers. Secondly, there is a preference for being able to control events which brings up the question of replicability. Would another person viewing the qualitative data of a case study come up with the same conclusions? Would another researcher be able to replicate the entire case study from data gathering through analysis? "Observations tend to be unique and non-replicable." [Ref. 6:p. 2] The question concerning the replicability of a case study adds a degree of uncertainty to the research process [Ref. 4:p. 16].

Additional uncertainty also comes from lack of detail in the documentation that case study researchers provide on their methodology. Some past case study results have been found to be influenced/ biased by the researcher. A

contributing factor to this lack of documentation is the lack of accepted and standardized methods for qualitative data analysis, and a lack of a common language. [Ref. 4:p. 16]

There are several other drawbacks to the case methodology. The preparation of case studies is time-consuming and their documentation is voluminous. The fact that there is little basis for scientific generalization is also considered a major stumbling block [Ref. 3:p. 20]. A typical skeptic of case study research, who is immersed in the quantitative viewpoint, looks to conclusions of the research to be generalizable to other situations. This is not the intent of case study conclusions. "Case study conclusions are generalizable to theoretical propositions and not to populations or universes." [Ref. 3:p. 21] They are not even generalizable to other organizations. "In this sense a case study does not represent a 'sample' and the investigators' goal is to expand and generalize theories (analytic generalization) and not to enumerate frequencies (statistical generalization)." [Ref. 3:p. 21]

An example of a case study giving emphasis to a theoretical concept is as follows: the Cuban Missile Crisis. This exact situation will never happen again, but there are general lessons that can be learned. These lessons include "the management of the problem, and the role

of organizational routine in shaping events and decisions." [Ref. 7:p. 295]

The case study as a research strategy has been used in many different areas:

- policy, political science, and public administration research;
- community psychology and sociology;
- organizational and management studies;
- city and regional planning research, such as studies of plans, neighborhoods or public agencies,.... [Ref. 3:p. 16].

The use of case study research has also proven valuable to the information systems area. "The information systems area is characterized by constant technological change and innovation." [Ref. 2:p. 370] This change and innovation has an impact on management and organizational issues in an information systems department. Case study research has been able to provide valuable insights into these issues [Ref. 2:p. 370].

E. CASE STUDIES FOR TEACHING PURPOSES

According to Dorothy Robyn, "there are two criteria potentially present in any learning situation." [Ref. 8:p. 1] These two criteria are the content or specific knowledge to be learned and the learning process. The learning process concerns itself with presenting a general approach or methodology to problem solving and decision making. A student's knowledge and ability to deal with the reality of

life outside the classroom is dependent on both of these criteria. [Ref. 8:p. 1]

Case studies basically follow the principle of "learning by doing." Case studies present real life with all of its associated complexity. Experience with case studies provides students with exposure to a wide range of real life situations which could take a lifetime to experience personally. This experience offers a basis for comparison should the student run into the same situation outside the classroom [Ref. 9:p. 56].

For the most part, a classroom setting presents facts and situations which have only one right answer [Ref. 8:p. 2]. A student in a lecture/classroom environment is a receiver of facts [Ref. 9:p. 56]. Real life deals with situations in which not all the relevant facts of a decision are available or in which a decision is not straightforward in that there is no right solution. "Case studies are valuable lessons in teaching students the habits of diagnosing problems, analyzing and evaluating alternatives and formulating workable plans of action." [Ref. 9:p. 56] Additionally, students must learn that decisions are not just made from an analysis of the facts. "The decision is a political process...involving power and influence." [Ref. 6:p. 2]

Using case studies in learning situations provides a student with an opportunity to apply theory to a situation

within the safety of a classroom environment. In essence a case study is a "simulated experience." [Ref. 1:p. 109] An additional benefit is an ability to apply known theory to contemporary happenings to see if a theory holds true. If it doesn't, there is opportunity to search for reasons for a cause and effect. Debates between students over a cause, effect and solution to case study problems provides the benefits of requiring them to question their assumptions and to defend their positions on issues. Other benefits of the use of a case study in a classroom include teaching students the following skills: how to search for facts, choose between alternatives, and what questions it is essential to ask. [Ref. 8:p. 2]

Retired Navy Admiral Stansfield Turner believes strongly in utilization of case studies in a military classroom. He says, "Many of the education programs, are simply cramming officers' heads with facts rather than helping them to develop the skills to deal with difficult problems of leadership, strategy and management." [Ref. 10:p. 1] Admiral Turner feels that using the case study method "will help prepare students for the time when they rise to the level where they really have to make decisions for our country." [Ref. 10:p. 1]

F. METHODOLOGY OF THESIS CASE STUDY

The case study series that is the subject of this thesis concerns the chronological events of an organization during

a period of two years. The case series describes the maturing of an automated data processing division and its interactions with other departments of the organization in a Department of the Navy Headquarters Command. An organizational case study is defined,

> ...where you purposely observe the entire configuration of individuals and groups in the setting of an organization, ...and you observe events in the way that they naturally unfold, without imposing any sort of experimental controls or treatments whatsoever on what it is you're observing." [Ref. 6:p. 1]
>
> It is typical of organizational case studies to refer to the private mental state of individuals, to the privately held meanings that the surrounding organization has for them and to features of the underlying social structure none of which can be seen directly. [Ref. 6:p. 2]

A case study "treats people as the observable agents through which the unobservable forces of the organization act." [Ref. 6:p. 9]

The case study writer was a member of the automated data processing division and a primary participant in the day-to-day events that have been documented. There does exist the possibility for bias in the writing of this case study, but a conscious effort was made to avoid any potential for bias. For example, observation consisted of memory recall by the case writer and verification of observations by several of the interviewees.

The setting of the case study is a contemporary situation in that computers and computer systems management is a relatively new field within the past two decades. Of particular importance in this case study is the use of a

prototyping methodology for the development of the computer application and the use of a third generation software language. The evolution of a computer application over a two-year time period and the maturing of the organization responsible for its development in terms of organizational structure, policies and personnel are described. Sources of evidence included written documentation, interview and direct observation. The written documentation included user and system documentation on the application, and reports on the development of the application by contractor and in-house personnel. Interviews were conducted primarily over the phone with a total of 11 out of 15 of the principal players within the organization. Personnel interviewed covered the entire hierarchy of management, contractors, project officer, front line supervisors and worker personnel. A major caveat is that a few of the interviewees are still attached to the organization. Some of their input may have been tempered by still being involved with the computer application. The data presented by these interviewees may be shaded towards protecting the organization.

III. CASE STUDIES

A. INTRODUCTION

A series of six case studies is presented in this chapter. The primary theme in the case series is the development and life cycle management of the Officer Assignment Information System (OAIS). A secondary theme is the maturing of an automated data processing organization. Case study one contains the background events of OAIS development. It describes the implementation of the OAIS prototype and covers the timeframe of November 1982 through October 1985. Case study two presents the events preceding the implementation of the first major change to OAIS. These changes are a software conversion and an enhanced order-writing module. The time period covered is October 1985 through May 1986. Case study three concerns the failure of the new version of OAIS. Command, user and project officer reactions to the failure are addressed. Case study four presents the events leading up to a second try at implementation of a new version of OAIS. Also, during this time period of May 1986 through May 1987, the organization responsible for OAIS development is transitioning from one with an emphasis on development to one where production issues are of equal importance. Case study five describes the problems with the second implementation of the new

version of OAIS. Case study six describes the organization's recovery from the problems generated from the OAIS implementation and changes made to deal with present and future computer systems management.

Organization charts, where applicable, are contained within the body of the case studies. Appendix A contains a description of OAIS interfaces. Appendix B contains timelines and lists of NMPC-47 personnel for case studies two, four and six. These timelines document important OAIS and NMPC-47 events over time. This documentation can be used to clarify the case studies and be used in conjunction with the teaching notes contained in Chapter IV.

B. CASE STUDY ONE

1. Background

OAIS (Officer Assignment Information System) is the first in a planned series of four applications which combine to form the Naval Military Personnel Distribution System (NMPDS). NMPDS was designed to support the Distribution Division (NMPC-4) of the Naval Military Personnel Command (NMPC). The mission of NMPC-4 is to assign officer and enlisted active duty personnel in accordance with the needs of both the Navy and the individual's career, and to control the manning of activities as specified by the Chief of Naval Operations. The goal of the NMPC-4 mission is to "Put the right person in the right job at the right time."

2. Organization

Development and production of NMPDS are the responsibility of NMPC-47, the Distribution Support Department. As of October 1985, NMPC-47 was organized as per Figure 1. The Information Systems Development branch,

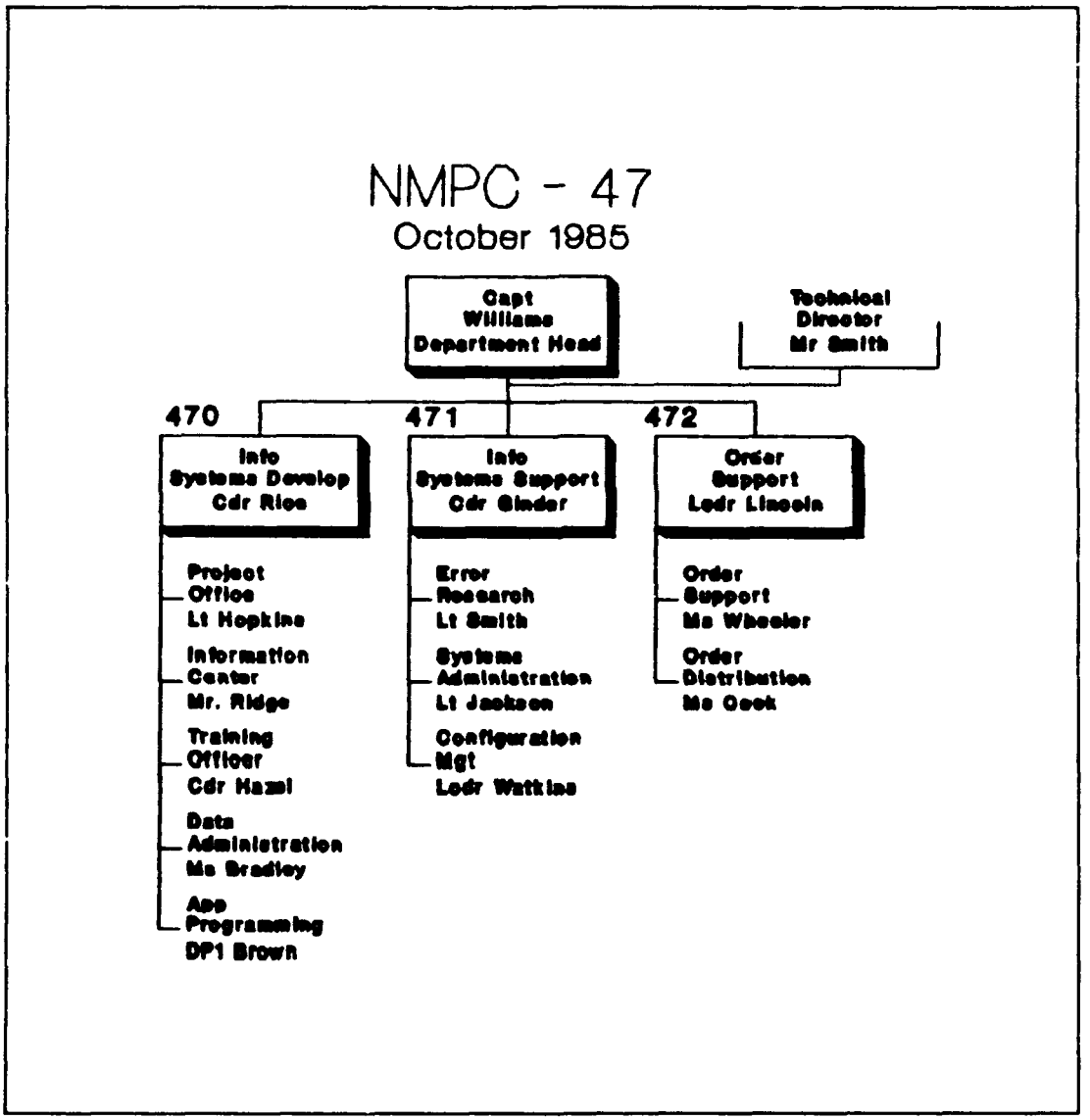


Figure 1. NMPC-47 Organization, October 1985

N470, was responsible for all development and production decisions concerning OAIS, On-line Distribution Information System (ODIS) and other systems which fell under the umbrella of NMPDS. The data administration function, training function, Application Programming Shop and Information Center made up the rest of N470. The Information Systems Support branch, N471, included Officer and Enlisted Error Research (help desk), Systems Administration (network hardware and software), Scheduling, and Configuration Management. The Order Support branch, N472, consisted of orderwriting experts and order distribution. Scheduling was responsible for running backups, batch updates, and daily, weekly and monthly OAIS reports. These reports were distributed by the Order Support branch, N472, to assignment and placement officers.

3. Background of NMPDS

NMPDS was designed to be a tool to help optimize unit manning, minimize personnel turbulence, minimize assignment costs, enhance individual career development, improve personalized service to constituents, and maintain accurate and timely personnel and distribution information.

Applicatic ithin NMPDS were planned to have the following characteristics:

- terminal driven.
- interactive data entry and transaction oriented.
- on-line information retrieval.

- distributed processing oriented to functional user.
- single point of data entry.
- standardized processes.
- central control of data, resources and telecommunications.
- modular structure for expandability and flexibility.

Two major guidelines, top management commitment and involving the user in all phases of development were agreed upon during the planning stages of NMPDS and would apply throughout the NMPDS lifecycle.

4. Officer Assignment Information System (OAIS)

OAIS automated the distribution process involved in assignment of officers to billets. OAIS was designed as a tool to facilitate and improve the assignment process by providing access to all officer distribution files through one computer application. The application provides information to both assignment officers (detailers) and placement officers.

The Officer Assignment Information System (OAIS) is a menu-driven, on-line, real-time application run on an IBM 4381 mainframe computer. Each user has a remote display terminal and keyboard connected via a local area network to a mainframe. By accessing either the Assignment Officer Menu or Placement Officer Menu, personnel information, activity billets and automatic orderwriting are provided. A report menu is available for generation of specific reports desired by users. A batch mode is used for system

maintenance, updating of files and production of large reports.

The manual steps involved with orderwriting were automated by OAIS. Before OAIS, orders typically took four to five weeks to get through the chop chain once an officer-assignment match was made. After OAIS, orders could be generated and sent within two to three days.

Information provided by OAIS falls into three main categories: personnel, activity and billet. Personnel information provided by OAIS includes: biographical, performance evaluation, duty preferences, and career history. Activity information provided is organization, administrative and mission specific. Billet information includes: billet titles, designators, subspeciality codes and manning requirements.

The network operating system for the IBM 4381 mainframe is IBM's MVS with CICS as the basic communications software in the multi-user environment. Communication between terminals, printers, and the IBM 4381 mainframe was conducted through the use of a bus local area network. The local area network and its associated bus interface units were owned by NMPC-16. Bus interface units are hardware and contain eight available ports for access onto the network. Bus interface units allowed flexibility in location and subsequent moving of OAIS terminals within an office space.

5. Users of OAIS

An assignment officer is responsible for the personal and professional interests of individual officers and assists them in pursuing their career. Placement officers ensure that each Naval activity is optimally manned with the best qualified officers. The job of being an assignment officer or placement officer included a lot of stress. There were pressures from senior officers to conserve money and pressures from activities to get the best officers for their command. Assignment officers spent most of their days on the phone talking to constituents about upcoming orders or counseling on career moves. A typical assignment or placement officer was a Lieutenant Commander or Commander. Often times they came from leadership positions of executive officer equivalence. They were used to having many people working for them. As an assignment or placement officer they were on their own with a constantly ringing phone and a computer application called OAIS.

Quick identification of personnel and billets coming up for reassignment are available with OAIS. The major piece of information that drives the reassignment (availability) process is the Projected Rotation Date (PRD).

Every active duty officer has a PRD assigned upon arrival at a new duty station. Depending on location and type of job, this PRD ranges from 12 to 36 months. The assignment officer will begin looking for billets for

personnel with PRD's six to nine months in the future. The placement officer is also looking at filling the billets made vacant on PRD's and advertises billets that will be coming available. Once the best officer-billet match has been determined by the assignment officer, OAIS facilitates the officer-billet match approval process and orderwriting process. The approval process consists of an automated chop chain which routes the proposed officer-billet match through the appropriate personnel. The automated chop chain facilitates expediency and communication between the assignment and placement officers. The orderwriting process includes decisions on training (what, where, how long) and costing of orders. The information necessary for this portion of the process was automated, replacing paper charts and schedules.

Improvements were made by OAIS in three categories: data accuracy, naval resource utilization and officer morale. Improved data accuracy resulted from automation of previously manually maintained distribution information. Improved naval resource utilization resulted from having billet assignments made from a larger pool of candidates, decreased incidence of inaccurate reporting instructions on PCS moves and misassignments. Improved officer morale resulted primarily from a reduction in the amount of time required for the assignment process.

6. Software Development

OAIS software was developed using a prototype methodology and a language called Application Productivity Systems (APS)COBOL. APSCOBOL was developed by SAGE Federal Systems. It is a third generation software language designed to produce COBOL code very quickly. Application generators are used to produce source code from high level specifications, reduce programming of certain system functions and enable junior programmers to produce sophisticated code with little training. Additional benefits of APSCOBOL were its advertised transportability between various types of hardware and its upwardly compatible design. Other software tools used during development were screen painters which assisted in configuration of data entry screens and report generators which facilitated access to specific data from files for generating reports.

The current instructions regarding development of information systems did not include prototyping as a methodology. Events which took place during OAIS development were matched as closely as possible with the Life Cycle Management Milestones which was directed under current software development instructions.

When the OAIS project was first established, the hardware on which the application operated was leased. This decision was due to a necessity of proving the quality and

efficiency of OAIS and subsequently NMPDS before additional resources were expended. Also, the procurement process for the hardware was not completed and management was not sure exactly what type of hardware would be contained in the final contract.

The benefit of an upwardly compatible design was that in subsequent revisions to the software code, only minor changes would be required to change over to a new version. The compatibility feature was part of SAGE's design architecture.

The initial version of APSCOBOL was JK, with the next version called one point seven (1.7). When NMPC procured APSCOBOL, it was not yet available commercially. NMPC was able to get a good deal on the price and be on the leading edge of technology. A prototype approach was used for a variety of reasons. One was the necessity of automating the assignment process as quickly as possible. A study group had been studying the assignment process problem since 1978. A prototype approach also would assist in determining just what OAIS was to do by giving users a concrete example to illustrate their ideas and requirements on. The original version of OAIS was just automation of the manual officer assignment process for the Surface Distribution Department.

7. Implementation of OAIS

Development and implementation of OAIS was done in a modular fashion. In November 1982, the Surface detailers (NMPC-41) were used to test and modify the pilot prototype. When time came to take the tested and approved prototype and complete the design and development process, the Surface detailers had become so dependent on OAIS that the decision was made by NMPC-47 to implement the prototype. Over the next 18 months the other officer oriented departments of the Distribution Division were brought on-line. See Figure 2.

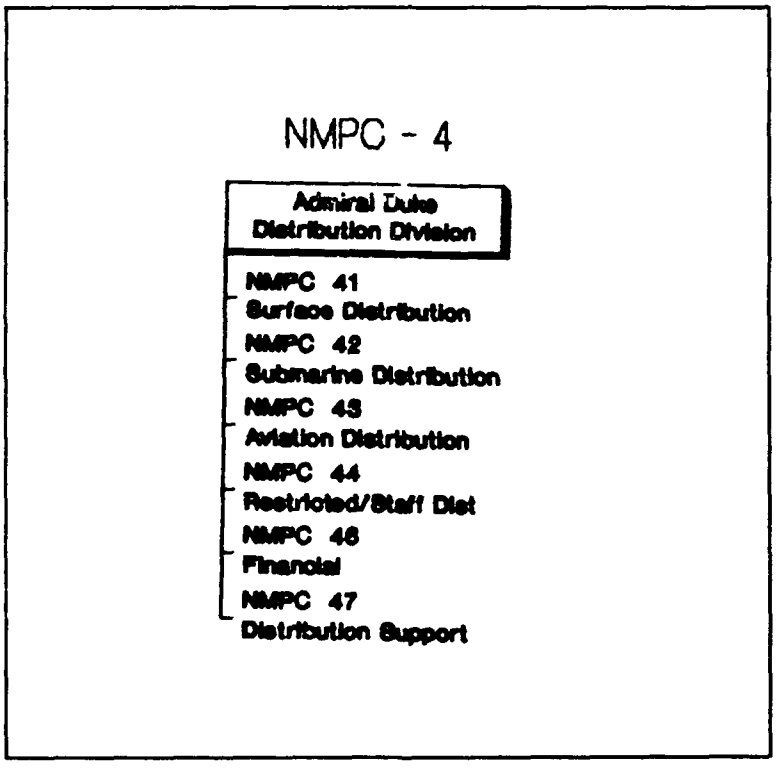


Figure 2. NMPC-4 Organization

Implementation of OAIS throughout the Distribution Division was done in a modular fashion for a variety of reasons. Among these were the original strategic plan of development and implementation in a modular fashion, problems with hardware acquisition and the need for minor modification of OAIS to accommodate each different department. A prime 750 mainframe computer, which is non-IBM compatible, was initially leased to run OAIS. Next, an IBM 4341 was leased until inhouse hardware was procured. During this period, 1982-1985, the scope and capabilities of OAIS could not be expanded to satisfy more users.

Assignment and placement officers' way of doing business was drastically changed by OAIS. Terminals replaced paper passed from desk to desk. Secretarial jobs changed from being purely clerical to a required interaction with a computer and computer-driven reports and processes. Even though OAIS was available on every desk, many personnel did not initially use the computer application. Reasons for non-use by the assignment and placement officers ranged from being afraid of the computer, to already using another personally-owned computer system, to being stuck in the old ways of having their secretaries do the clerical work on the computer while they planned in a manual mode. The Medical Department, within NMPC-44, was one of the divisions using personally-owned computers. They had set up files on their constituents using a database system. This system worked

fine until the assignment officers transferred and took their computers with them. Mrs. Clancey, a secretary in NMPC-44, refused to turn on the computer. She continued to use her manual methods.

In the Submarine Department, OAIS was utilized far more than in other recently implemented departments. This was due to the top management commitment of the Submarine Department. These personnel came from a technical background and did not fear the computer coming into their workplace. Due to their bosses' support of OAIS, all the personnel within the department were soon proficient on OAIS.

Placement officers were one of the last groups of users to climb onboard the OAIS bandwagon. Before OAIS, placement officers maintained their personnel lists on a manual slate with a strip of paper for each officer in each billet at an activity. In one glance they could determine a status of their billets at any activity With OAIS being constrained by the number of lines per screen, an entire activity could not fit onto one screen. In the eyes of a placement officer, this was a major drawback to the application. Until the orderwriting process was automated in 1985, there was really no benefit to them to using OAIS.

8. User Representatives

Each officer distribution department was represented by a user representative, selected by the department head.

This user representative was supposed to be experienced with OAIS usage and functions. The responsibilities of user representatives included attendance at OAIS user meetings, reporting back to their department issues of the OAIS user meetings, and bringing problems of the department to the meeting. Also, any suggested enhancements to OAIS from individual departments were to be routed to their respective user representative for review. It was the responsibility of a user representative to pass OAIS information around the department, so that each individual OAIS user was not calling the help desk.

9. Training

The importance of training was discovered in parallel with the expansion of OAIS users to the Submarine and Aviation communities. Training had not been a problem with the Surface Department due to their daily involvement with development. Their sense of ownership of OAIS promoted self-training. CDR Hazel was brought on-board in July 1984 to be the Training Officer and to design a training program and OAIS User Manual. CDR Hazel became the resident functional expert on OAIS and on the specific needs of assignment and placement officers. The Training Development Project was established. A contract was arranged with Oak Ridge Associated Universities in Oak Ridge, Tennessee, to develop computer-aided training. This training would serve

OAIS, and ODIS users, who were figured to number in the hundreds.

10. Documentation

Due to budget constraints, the push for software development and implementation of the prototype, there was a significant lack of operational and requirements documentation on OAIS. Original documentation provided by the contractor was of poor quality. There were no detailed requirements documents. The majority of the documentation was contained within the comment portion of the code. The first user's manual was published in January 1985. Planning documents included functional descriptions for OAIS and NMPDS, operational requirements for OAIS, system specifications for OAIS, conceptual design for OAIS, program specifications OAIS and data base specifications for NMPDS.

C. CASE STUDY TWO

1. Background

The Officer Assignment Information System (OAIS) which is used by the assignment and placement officers at Naval Military Personnel Command has been operational for three years. The organization responsible for OAIS is on the brink of many changes: personnel, software and hard-ware. The personnel responsible for planning and bringing the OAIS concept to reality in NMPC-47 and at the contractor are leaving. A new project officer is taking over at a time when the first major software change to OAIS is in progress.

The first of four IBM mainframe computers, an IBM 4381, has been delivered after an exceedingly long procurement period.

2. New OAIS Project Officer, October 1985

LT Hopkins arrived at NMPC to be the OAIS Project Officer. She had just graduated from the Naval Postgraduate School with a Master's Degree in Computer Systems Management. She relieved CDR Zeke who was the initial project officer for the OAIS project. CDR Zeke had been responsible for the growth and maturation of OAIS. He had seen it grow from a fledgling system with 50 users in 1982 to a powerful system upon which NMPC assignment and placement officers were now heavily dependent. OAIS users numbered approximately 300.

The mindset of the project officers when LT Hopkins arrived concerning the contractor, SAGE, was, "We are paying big bucks for a quality product." The contractors were taken at their word concerning all aspects of system development and production and they had been proven correct in the past.

The contracting and budget portions of the job were a particular difficulty for LT Hopkins. The primary contractor for OAIS was Oak Ridge National Laboratory (ORNL), a division of the Department of Energy. The contract with ORNL was a research and development contract. There was not much substance nor specifically spelled out deliverables. The emphasis was on the research and

development of the prototyping methodology. SAGE were sub-contractors of ORNL. In order to get contracting changes through to ORNL, approval was required by the Total Force Automated Systems Department (NMPC-16). NMPC-16 was responsible for all automated data processing programs and related support. Since OAIS was now three years old, they viewed contracting charges in terms of maintenance and as they conformed with the Life Cycle Milestone methodology.

3. Personnel

The majority of OAIS history and expertise existed in the brains of CDR Zeke and the project manager at SAGE. When the poor quality documentation was delivered by SAGE, CDR Zeke said, "Don't worry about it, we know what we are doing." When LT Hopkins relieved CDR Zeke, the project manager at SAGE transferred to another project. The personnel left within NMPC-47, familiar with OAIS history and its evolution were Mr. Smith, the Technical Director and the two branch heads, CDR Rice and CDR Cinder. CDR Rice and CDR Cinder had been on-board less than a year.

Besides CDR Zeke, the other major player in the evolution of OAIS was CAPT Dennis. CAPT Dennis had been the NMPC-47 Department Head from 1983 to August 1985. CAPT Williams had just recently relieved him.

CDR Hazel, the current Training Officer, was offered the job of OAIS Project Officer before LT Hopkins reported aboard. He turned it down as it was described as a

caretaker job and CDR Hazel always enjoyed a challenge. LT Hopkins was informed of CDR Hazel's expertise by CDR Zeke and he recommended that she utilize CDR Hazel's knowledge.

LT Hopkins kept to herself and did not try and make the acquaintance of her fellow officers within the department.

LT Perkins reported on-board in December 1985. She was designated as the replacement for CDR Hazel, who was moving up to be the Order Support branch head. CDR Hazel left LT Perkins alone with OAIS for two weeks while on vacation. With his assistance on orderwriting procedures, LT Perkins became a functional OAIS expert second only to CDR Hazel. CDR Hazel and LT Perkins became good friends.

CDR Griffin reported on-board in April 1986. He had just graduated from the Naval Postgraduate School and was to be the branch head of Information Systems Support. See Figure 3.

4. NMPC-47 Organization

CDR Rice and CDR Cinder had worked out an informal matrix management plan for accomplishment of OAIS taskings within NMPC-47. Programming expertise existed and was being nurtured in the Application Programming Shop of the Information Systems Development branch. The original plans for OAIS called for SAGE to create the first version of OAIS and for the Navy to take over maintenance of the project afterwards. Towards this end, the Application Programming

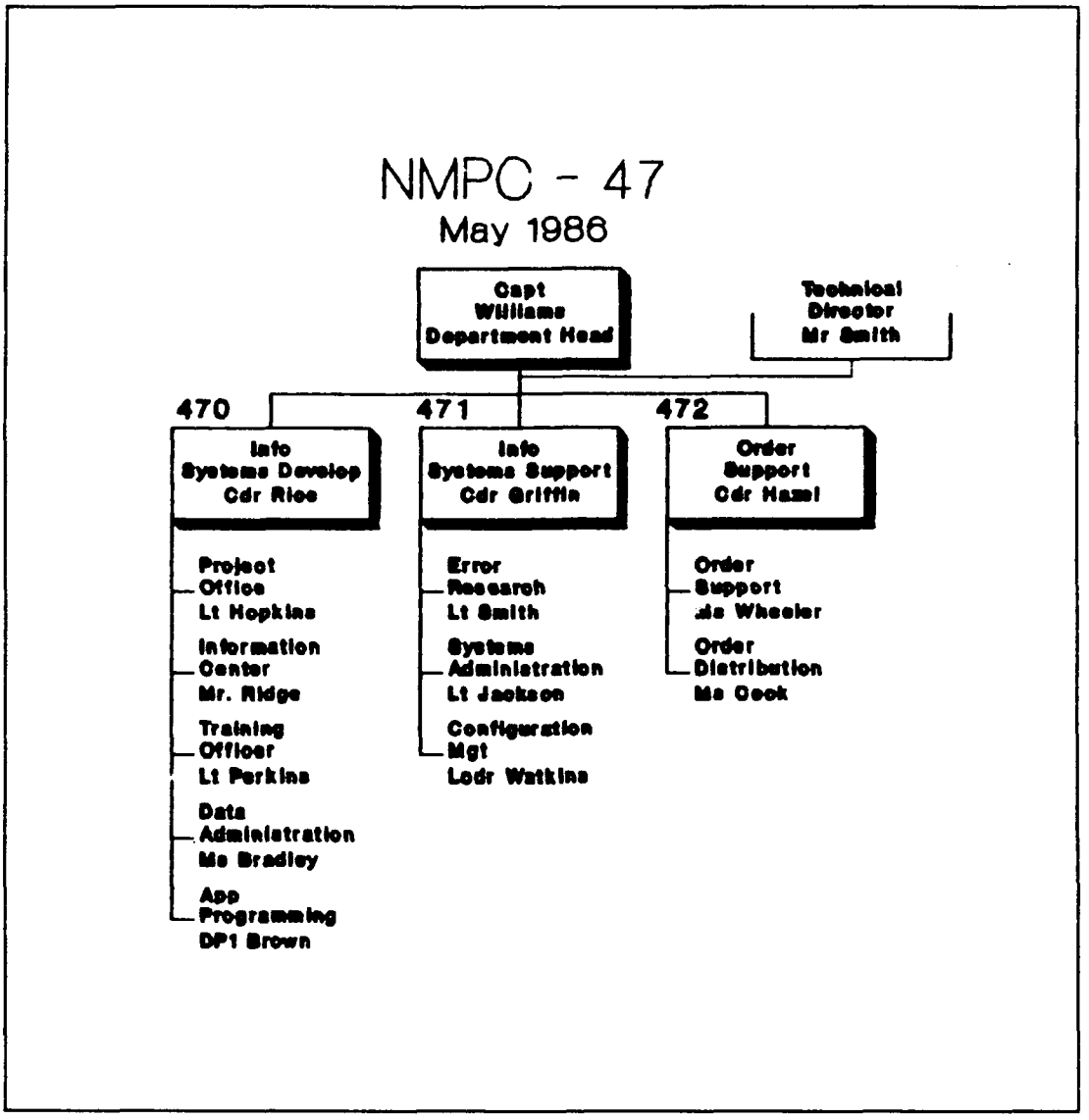


Figure 3. NMPC-47 Organization, May 1986

Shop was being expanded by adding experienced Data Processing Technicians (DP's). Expertise on the external programs with which OAIS interfaced, existed in the Information Systems Support branch, N471, in the Officer Error Research section. Officer Error Research also handled

users' problems concerning AUTONOM rejects and tracking the status of officer orders. Hardware and systems software expertise was also contained within the Information Systems Support branch, in the Systems Administration section.

When LT Hopkins needed assistance or technical advice, she went to the experts within the matrix. Quite often, personnel in the Information Systems Support branch were tasked by LT Hopkins without their supervisors being aware of it. LT Hopkins was under pressure and her approach to her problems was blunt and aggressive. She would approach enlisted personnel and fellow officers with, "I want this done now."

Personnel in the Information Systems Support branch, N471, were not included at NMPDS planning meetings. Though N471 personnel kept the current systems going from day to day, any problems encountered were considered status quo. They were told by CDR Cinder that OAIS would solve all of their problems. Focus was on development and the future. Towards this end, CDR Rice and CDR Cinder had developed extensive integration plans. Having the Order Production Module (OPM) would enable the combination of officer and enlisted order generation. They envisioned the combination of the Officer and Enlisted Error Research Sections.

LT Smith, in charge of the error research divisions, felt a lack of connection between reality and the integration plans. She convinced CDR Cinder to hold off on

the integration plans for the error research division due to the vast differences between the officer and enlisted programs through which OAIS and EAIS interfaced.

LT Smith was not invited to attend OAIS User Representative meetings either. Though her personnel were tasked by LT Hopkins and were responsible for answering error research questions and investigating AUTONOM rejects, she was not included. However, she attended as many meetings as possible.

5. Training

LT Perkins was not as busy as she was used to, having just come from an officer-in-charge billet. A new list of users was provided by Configuration Management on a weekly basis to LT Perkins. LT Perkins would visit the personnel individually and offer them training. Training consisted of hands-on training for OAIS and ODIS. In some divisions, the OAIS user representative would set up training for their new personnel, knowing the full value of training by LT Perkins. In other divisions new users decided they did not have time for training in the short turnover period.

LT Perkins felt left out of the main stream of activities. There were no professional nor friendly overtures from personnel within the OAIS project through which she would naturally have interfaced.

6. OAIS Planned Changes

When LT Hopkins took over, plans were already underway at the contractors for a conversion of the software version of OAIS. The first version of APSCOBOL was JK and it was developed in 1981. Since that time, SAGE had discovered quite a few problems with the code and wanted to enhance their product. SAGE announced that they were discontinuing support for the JK version.

In addition to the software conversion, the orderwriting portion of OAIS was redesigned. The current orderwriting procedures were just an automated version of the manual method. With the advent of automation and the input of several serious users, shortcuts and enhancements were needed and desired to the orderwriting process. Also, it was planned that the Order Production Module would take the place of AUTONOM. The Order Production Module would be the responsibility of NMPC-47, in addition to supporting an increased variety of order formats as compared to AUTONOM capabilities. Over the three years of OAIS production, reliance on AUTONOM without a formal level of service agreement with NMPC-16 had been a cause of many problems concerning late or missing updates and production of hard copy orders.

7. Navy Programming Responsibilities

The job of writing the new orderwriting procedures was given to the Application Programming Shop. This shop

consisted mostly of programming experienced, Data Processing Technicians (DP). The DP in charge was DP1 Brown. DP1 Brown took the responsibility for rewriting the orderwriting procedures. He and a few DP's worked relatively on their own at NMPC.

The contractors were responsible for conversion of the existing OAIS code, both batch and online, and the correction of several trouble reports. The grand plan was that the DP's and the contractors would work closely together, so that the DP's could become more familiar with OAIS programs which they were due to take over after this conversion effort. Some of DP's and systems administration personnel worked with the contractors at their site in Rockville, Maryland and assisted with the conversion.

There was little coordination between DP1 Brown and the personnel at SAGE prior to implementation. Also, a late decision was made concerning the OPM. It was determined that it would not be ready in time for a May implementation, so the new version of OAIS had to be jury-rigged to interface with AUTONOM. Bits and pieces of the new software were tested separately, but there was not a complete test of the OAIS application nor a systems stress test to check the performance of the hardware with the new version of APSCOBOL.

LT Hopkins asked questions about testing procedures, but was inexperienced and really did not know the right

questions to ask. Also, at this time there was no separate test vehicle available for testing. The testing that was done was done on a timesharing basis, with batch production jobs, in the evening hours.

8. Preparation for May 1986 Implementation

In preparation for the new version of OAIS set to come on-line in May 1986, LT Perkins updated the orderwriting procedures for inclusion in the OAIS User Manual. In April, CDR Hazel and LT Perkins arranged training sessions with the OAIS users in a conference room to review changes to OAIS and to distribute the updated OAIS User Manual.

On the first day of production for the new version of OAIS, LT Hopkins waited impatiently in her office to hear how OAIS was doing. This was her first time managing a computer software project as well as being her first major accomplishment at the command.

D. CASE STUDY THREE

1. Background

A new version of OAIS with an ungraded version of software and an enhanced orderwriting module was implemented two days ago. These changes were the first major changes made to OAIS. A combination of Data Processing Technicians and contractor personnel worked on the programming portion of development. There had been little liaison between OAIS project team members and no separate test vehicle to support

on-line testing of OAIS changes. Up until this point, OAIS had been the darling of Naval Military Personnel Command both for the enhancements it had made to the officer distribution process and its ability to provide up-to-date information.

2. Command Decision

CAPT Williams, NMPC-47 Department Head, slowly walked back from conferring with his boss, Admiral Duke. Admiral Duke was the head of the Distribution Division. The hastily-called meeting concerned the poor performance of the new version of OAIS that had just been implemented two days previously. Admiral Duke had received numerous complaints about OAIS' slow response time and downtime (unavailability) from the department heads responsible for Surface, Aviation and Submarine officer distribution. As usual, Admiral Duke wanted to know why. He did not understand computer terminology and thus it was even harder for CAPT Williams to explain the complications. All the Admiral understood was that orders were not being processed and sent out.

Several options had been discussed at an earlier meeting with NMPC-47 branch heads. One option was to keep OAIS up so that the problems and causes of the slow response time could be determined. The contractors favored this approach since the majority of the change was the newly converted software code. The disadvantage of this option would be a continued lack of orders and with the slow

response time, many users would not use OAIS. The users wanted the old version of OAIS back so that they could get orders out. By going back to the old version, several enhancements lobbied for by the users and an enhanced orderwriting module would be lost. These users were still the first generation of users and remembered life without OAIS. They had no experience with making the best even better. NMPC-47 realized that going back to the old version of OAIS would mean a loss of credibility with users and other organizations and an increase in resources necessary to solve the problem off-line, including manpower, dollars and time. Production issues involved getting OAIS JK back on-line, running all the updates from external interfaces and cancelling the updates generated by the new version of OAIS to external interfaces. The users would lose all the work that they had been able to get done on OAIS 1.7 and the time needed to get OAIS JK running again would cause OAIS to be unavailable to the users.

CAPT Williams told YN3 Smith to contact the branch heads, CDR Rice in charge of N470, Information Systems Development branch; CDR Griffin in charge of N471, Information Systems Support branch; CDR Hazel in charge of N472, Order Support branch; and LT Hopkins who was the OAIS Project Officer. All players had met on numerous occasions over the past two days trying to determine just what the cause of the OAIS problems was. Once everyone was assembled

in his office, CAPT Williams announced his course of action. "Take OAIS 1.7 down immediately and restore OAIS JK (old version) as soon as possible. At yesterday's status meeting I was told it would take 14 hours of contractor time to restore the old version. I want an estimate of when the old version of OAIS will be available for detailer use. Jeff (CDR Hazel), I want your staff to work overtime if necessary to get any priority orders out manually. That's all."

It was a silent group that walked out of the CAPT's office. Very rarely had they seen the CAPT this angry. CDR Rice was fuming. OAIS was his pet project and had been the darling of NMPC until the past few days. LT Hopkins, a recent graduate of the Naval Postgraduate School, could not believe how wrong things had gone. CDR Hazel thought to himself, I tried to tell them it wasn't ready and shouldn't be implemented. Now we'll all have to live with the consequences.

3. Responses

CDR Griffin was the most recent addition to NMPC-47, having been on-board only four weeks. CDR Griffin was also a recent graduate of the Naval Postgraduate School. He did not want to have to tell CAPT Williams that it would take more than 14 hours of downtime to restore the OAIS JK version. CDR Griffin thought the project office people always conveniently seemed to forget the production portion of the business.

User confidence in OAIS was shaken. There were some dissatisfied users due to promises of enhancements to be contained within OAIS 1.7, which were now delayed for an indefinite period of time.

Tempers were high and finger-pointing was rife within NMPC-47 and SAGE. DP1 Brown, who was in charge of the Navy's portion of the joint effort between the contractor and the Navy, bore the brunt of the blame. The attitude and arrogance on the part of the DP's was criticized.

The main problem identified with OAIS 1.7 was degraded system performance due to the enormous demands made on the system from the converted code. This slowed response time to users and overtaxed the Central Processing Unit (CPU). When CAPT Williams had the new version of OAIS brought down, SAGE, the contractors, were all for keeping the new version up so that they could understand and work with the problem.

LT Hopkins adopted two changes to her management techniques of OAIS. She decided to modularize OAIS into smaller portions and have test plans drawn up for each screen, module, program and interface of OAIS.

4. Contract Change

About this time, OP-01, the department in charge of manning plans for the Navy, slashed the DP manning requirements for NMPC-47. NMPC-47 knew that they did not

have the personnel nor the expertise to maintain OAIS. This big change to the game plan required internal and external changes.

In June 1986, SAGE was approached by NMPC-47 top management personnel, CAPT Williams and Mr Smith, concerning taking over the maintenance of OAIS in addition to their current responsibility for development. This change in tasking required changes to the contract.

During this renegotiation, SAGE demanded that they be given full control over OAIS programming. A prime complaint of SAGE's was a lack of control for the full system when part of the programming was being done by Navy DP's. SAGE attributed this lack of control to being a major cause of the recent failure. Having complete control would enable the contractor to have complete confidence in and responsibility for the results when it came time for implementation again.

E. CASE STUDY FOUR

1. Background

NMPC-47 had just put the old version of OAIS back into production after two days of user complaints concerning slow response time. It was the first time a major problem had developed with OAIS. LT Hopkins made two changes to her management techniques. She wanted OAIS broken into modules and test plans developed for each screen, menu and program. The contractors took on the responsibility for both OAIS

development and maintenance. It was a time for coming up with solutions to the OAIS problems and organizational change.

2. Transition of N471 to a Full Production Division

Throughout the fall of 1986, NMPC-47 experienced the growing pains of transition from a development-oriented division to one where production was of growing importance. Up to and including the present time, the day-to-day running of the department was driven by CDR Rice's priorities and those of his project officers. Even though OAIS was a production application with all intended users on-line, OAIS was handled as an application still under development.

The day-to-day decisions concerning OAIS production issues were handled by LT Hopkins. These included production-oriented decisions such as scheduling of batch jobs, updates, downtime, user impact, running of OAIS user meetings, production of OAIS User Bulletins and responsibility for daily messages on the OAIS sign-on screen.

The failure of OAIS 1.7 seemed to highlight these growing pains and brought into focus such issues as matrix management, customer support and training. The bottom line was that users had become highly dependent on OAIS for accomplishment of their daily work.

3. CDR Griffin Changes to N471

CDR Griffin was the primary force behind the transition of the Information Systems Support branch, N471, into the branch responsible for production decisions. In addition to the issues of customer support and training, systems maintenance and production scheduling were becoming more and more important. The informal matrix management established between CDR Rice and CDR Griffin's predecessor was done away with. Training was moved from N470 to N471. See Figure 4.

CDR Griffin changed the mission of the error research personnel from being responsible for a portion of the OAIS user interface to being responsible for all customer liaison with OAIS users. The name of this newly tasked division was the OAIS Help Desk. LT Perkins, the current Training Officer, was identified as the logical person to head up the OAIS Help Desk because of her current involvement with the assignment and placement officers and her functional knowledge of OAIS.

A training room was set up in an unused conference room. Approximately eight extra terminals were set up for training of either individuals or groups of users. Scheduling of the conference room was the responsibility of the training officer. Training evolutions had first priority for usage of the room. The room was windowless with no air circulation or ventilation.

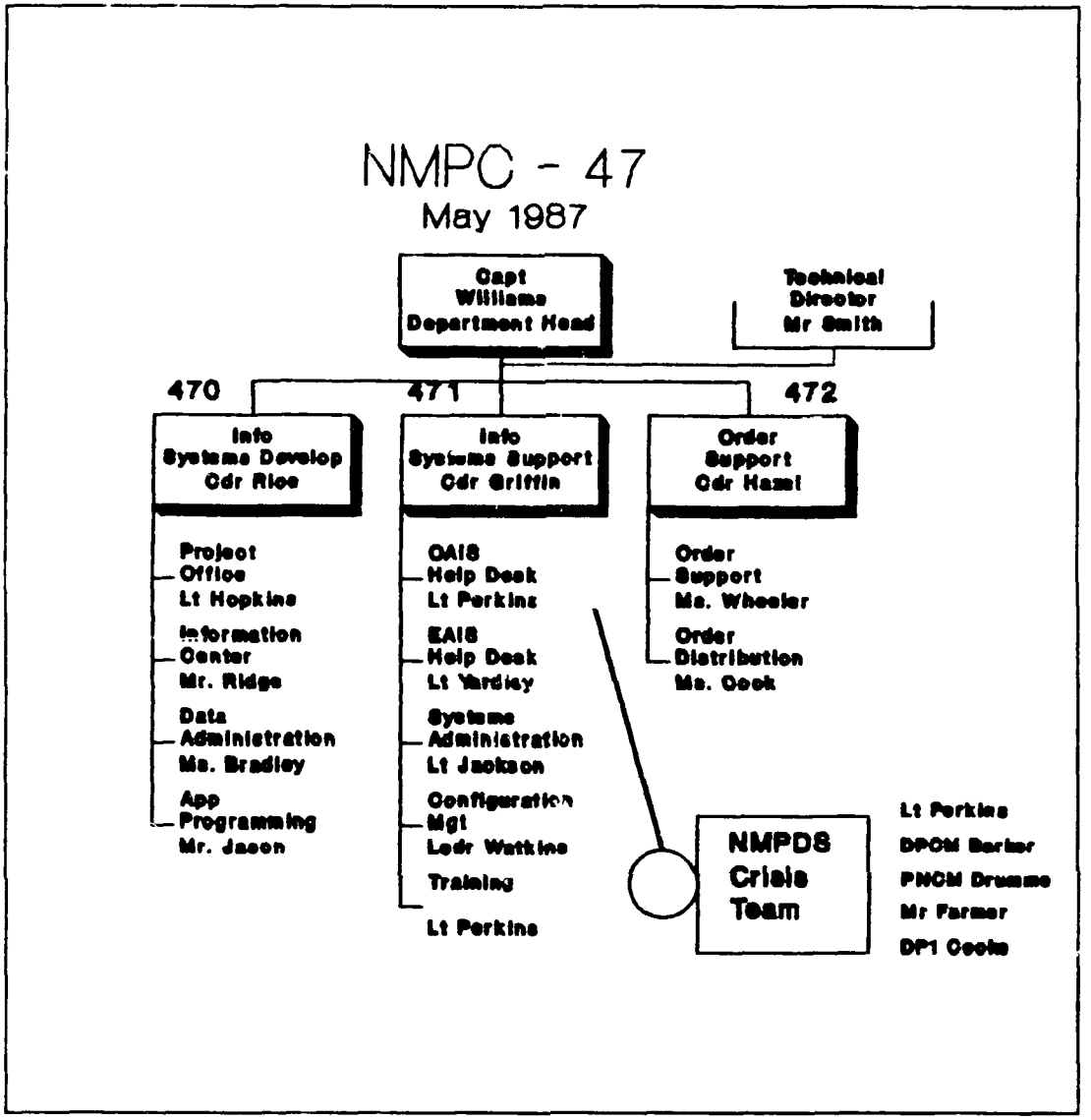


Figure 4. NMPC-47 Organization, May 1987

CDR Griffin developed an NMPDS Crisis Management Team. This team was composed of an expert from each area of N471. These areas included Configuration Management, OAIS Help Desk, Systems Administration and a variety of other people depending on the problem. This group was headed by

CDR Griffin and manned by technical personnel, not managers. Problems were explained, solutions discussed and a decision to remedy the situation was made immediately. See Figure 4.

4. Conflict Between N470 and N471

There was conflict between N470 and N471 primarily due to allocation of resources between application development and application production. Up until this point in time, the emphasis in NMPC-47 had been on development issues. OAIS expertise had existed only in N470, the Information Systems Development branch. With OAIS usage growing and subsequently dependence on the application, other considerations were necessary. Maintenance of systems software and hardware were a necessity. Additionally, confusion on reporting responsibilities that a matrix management system wrought on functional management was exhibited.

LT Perkins and LT Hopkins were constantly at loggerheads over responsibility of the day-to-day activities of OAIS. Both CDR Hazel and CDR Griffin agreed with LT Perkins that operational control of OAIS belonged in Information Systems Support branch, N471, vice the Information Systems Development branch, N470.

The offices of LT Hopkins and LT Perkins were separated by two long hallways. LT Perkins' office was located next to the OAIS Help Desk and Systems Administration where OAIS operations were monitored. When a

glitch developed during the course of a work day or a crisis was identified, LT Perkins had to consult with LT Hopkins. This wasted valuable time concerning both a fix and notification to the users as to OAIS status. This wasted time during a crisis added to the adversity between LT Hopkins and LT Perkins.

Not only was there a struggle between LT Perkins and LT Hopkins, but there was one between the branch heads, CDR Griffin and CDR Rice. There was disagreement when it came to allocation of resources, both personnel and money, as well as the priorities of systems maintenance and enhancement versus software development. Systems maintenance was continually put off until there was time for it. Time seemed to be found on Saturday and Sunday mornings.

By the spring of 1987, full control of day-to-day operations of OAIS were within N471, the Information Systems Support branch. The upcoming retirement of CDR Rice hastened the process. CDR Rice's replacement was LCDR Wall. LCDR Wall was more receptive to new ideas, more politically oriented, as well as being junior to CDR Griffin.

LT Perkins took over full responsibility for production decisions and scheduling of batch jobs. She also took over responsibility for OAIS User Bulletin publishing and distribution.

5. OAIS Help Desk

The mission of the OAIS Help Desk was to improve the current level of user assistance. Instead of OAIS users having to contact various representatives within NMPC-47 for assistance with different problems, the OAIS Help Desk would be the single point of contact. This included questions on OAIS usage, orderwriting, hardware problems, updates of information and the status of OAIS.

Naturally there were growing pains. NMPC-47 workers had to learn to say, "Have you contacted the Help Desk?" instead of running out to fix a problem. There was extreme difficulty in areas where ego was associated with power. One of these areas was hardware maintenance. It was very hard for the hardware maintenance personnel, who up to this time had been worshipped as heros due to their knowledge of computer hardware, to become part of a total customer service concept. Also users had found shortcuts or their favorite helpers and constantly called them.

The enlisted personnel manning the help desk phones had to increase their knowledge of OAIS as well as learn patience for frustrated users. When OAIS did not work correctly, was down or contained bad information, the people that bore the brunt of user frustration were the OAIS Help Desk personnel and LT Perkins. If an officer was not satisfied with the answers provided by the OAIS Help Desk, they would call CDR Griffin, CDR Rice or even CAPT Williams.

Users had to learn that the OAIS Help Desk would get the job done.

The phone calls to LT Hopkins concerning OAIS Help Desk issues were of particular note. LT Hopkins would usually proceed to investigate the problem on her own without informing LT Perkins until later.

LT Perkins spent a lot of her time educating users with reminders of, "Next time please call the Help Desk" and building customer trust in herself and her personnel's performance.

6. OAIS Help Desk Phone Log

A phone log procedure was implemented in order to be able to track incoming requests and to conduct a follow-up when users called again. Several cases of help requests not being fulfilled, with users complaining to CDR Griffin, fueled this change.

User name, time, date of call and complaint were logged. Calls pertaining to hardware problems or User Id's needing reset were given a control number and sent to the appropriate section of N471, the Information Systems Support branch for correction. This process established an auditing activity of the log book by LT Perkins from which she could detect the flavor of calls and identify any particular trends or problems pertaining to training.

7. Growth of User Base

As each day went by, the number of users on OAIS and ODIS continued to rise steadily. Requests were received from outside of NMPC for access to the application. A major policy decision was made that NMPDS information was just for Distribution Department purposes. Problems were encountered as the number of users increased.

8. Port Pirates

There were more terminals than there were ports on the bus interface units of the local area network. Primary users of NMPDS were designated as NMPC-4 and NMPC-2 personnel. Other users were secondary. Primary users were assigned by division, a range of port numbers (one for every user) which were theirs to use. Specific port assignment was left up to a division. Secondary users were assigned a few port numbers. The policy for secondary users was use OAIS and then sign off the port so that other personnel could have access. If more personnel than there were ports available wanted to get on OAIS, they had to port pirate.

Port pirating involves trying various port numbers to see if they were vacant to get on OAIS. If a primary user's port was pirated he would call the help desk for resolution. The port pirate was bumped off the pirated port and the primary user was able to sign on. Particularly on a Monday morning, a large amount of the calls to the help desk were those complaining of port pirates.

9. OAIS Dependence

A crisis seemed to develop quickly whenever a problem with OAIS occurred, whether it be a bad back-up tape from the Officer Master File (OMF) or a hardware failure. This crisis environment was due to the heavy dependence of assignment and placement officers on OAIS. Also, senior personnel within NMPC had come to rely on OAIS to supply them with information on personnel, tracking of orders and for answering questions from Admirals and the Fleet. Due to this dependence on OAIS, CDR Griffin required LT Perkins or one of her personnel to personally deliver an OAIS User Bulletin or message concerning OAIS downtime to NMPC-47's Captain and the Admiral (NMPC-4).

10. Experienced Users

The users were becoming comfortable with computer usage and OAIS. With this comfortableness the users started coming up with better ways of doing things and ideas on automating other parts of their workload. Their ideas were turned into LT Hopkins in the form of a Software Change Proposal (SCP). LT Hopkins' response was that NMPC-47 would consider the changes after the new version of OAIS came up.

It was during this timeframe that shortcuts to circumvent the chop chain and unprotected data fields within OAIS were discovered by the OAIS hackers (expert users). When these were discovered by NMPC-47, fixes were quickly implemented. One of the hacker changes included using one

of the orderwriting screens for sending messages to other personnel in the chop chain. This discovery prompted an addition of a message screen for such a purpose in the new orderwriting menu to be implemented with the 1.7 conversion.

The Aviation Department was using a screen designed for the Submarine Department. The screen was designed to keep track of hulls and Unit Identification Codes (UIC) assignments for new submarines, but the Aviators were using it for their in-house telephone directory.

Other abuses of OAIS included personal utilization of information covered by the Privacy Act. Such abuses included checking out a medical doctor or lawyer's history and fitness reports prior to using their services.

Screen by screen access was monitored by Configuration Management. Decisions concerning access or denial of access came through the chain of command of a new user, to their user representative and lastly to LT Perkins for final approval. One security precaution had been specifying the rank level for fitness report review. For example, an Ensign was typically granted access to only Ensign or Lieutenant Junior Grade fitness reports unless their job required other access.

11. <u>OAIS user meetings</u>

OAIS user meetings were held on an as-needed basis. They were called for and run by LT Hopkins. User representatives from each division attended on a sporadic

basis. The focus of each meeting was usually development-oriented. Users continuously turned in additional requirements and enhancements for OAIS to LT Hopkins. All change requests were put on hold until OAIS 1.7 was implemented. LT Perkins attended these meetings, but rarely had anything to discuss save trouble reports called in to the OAIS Help Desk.

12. OAIS User Bulletins

Information concerning OAIS was also promulgated by use of OAIS User Bulletins. These OAIS User Bulletins were sent to every OAIS user on an as-needed basis. Green paper was used so that they would be easily distinguishable in a basket full of papers. Information such as scheduled downtime on a weekend or a trend of problems noticed by the help desk were contained on a User Bulletin.

13. Training

LT Perkins was still the Training Officer. Training continued as before. Some departing OAIS users scheduled training for their reliefs as they knew the full value of training by LT Perkins. In other divisions new personnel decided they did not have time for training in the short turnover period. New users got some on-the-job training from their predecessor and any problems they encountered they called the OAIS Help Desk.

These calls required OAIS Help Desk personnel to become quite familiar with all aspects of OAIS and brought a

slight change in their mission. Instead of just correcting errors in the final product, orders, or notifying the correct department for a hardware problem, OAIS Help Desk personnel learned to operate screens and understand the various portions of the officer assignment process. The acquisition of the whole picture at the help desk increased the number of "experts" on OAIS, who could be turned to in times of crisis.

14. Morale of N47's Data Processing Technicians

Morale of NMPC-47 DP's was a constant concern. Many of the positions were filled by first class or personnel on their first tour with the Navy. First class tours were six years. Unless they were able to get into the elite groups of the Information Center or Systems Administration, many got out. Personnel new to NMPC-47 were started out either at a help desk or in Scheduling. The Data Processing Technicians viewed the help desk job as that of secretary, which in their minds was a far cry from being a computer programmer. After some time they could be moved to other parts of the branch, in which their training would be of use, but there was no designated path of career progression. Changes in job description and division were determined by performance and vacancies. The expert status conveyed upon the members of the OAIS Help Desk significantly increased their morale.

The majority of DP's want to program. There was little programming to be done due to the integration and sharing of resources called for in the NMPDS plan. It was an accountability matter for the contractors that if they are held responsible for the program, they did not want anyone else to be allowed to make changes to it. The DP's responded to added pressures and high cost of living, which is synonymous with working in Washington D.C. at a headquarters command, by getting out of the service. Many were able to find lucrative jobs with computer companies and make more money.

15. System Administration Improvements

A test environment for OAIS, called TOAIS, was developed by the Systems Administration division. With CDR Griffin giving Systems Administration the emphasis it needed, future plans for hardware and software were expanded.

a. Security

A major issue in October 1986 was the introduction of a security system for signing into NMPDS. This security system would increase overall security and data integrity. The current procedures required specific signon procedures for each of the applications under NMPDS. The goal was a standard sign-on procedure. The first step was incorporation of an overall shell security system, called RACF, which when successfully accessed would allow

access to the other applications within NMPDS with their individual passwords. With RACF in place, users were required to remember their RACF password and their password for each application.

When RACF was implemented it was discovered that many users did not have their own User Id's, but used those of other personnel. This was a security violation. Each user is given capabilities and access to certain screens within OAIS based upon the job they are to fill in the assignment process. It was also discovered at this time that some assignment and placement officers had given their User Id's to their secretaries to do their work. In essence this was also a security violation as well as an avoidance of using OAIS.

It took a lot of work to get the RACF system working properly. Users had to acquire User Id's and they frequently forgot their password and had to call the help desk to have it reset. The help desk personnel had to ensure that the person who was calling for a User Id reset was actually the user.

b. NMPDS Dial-Up Capability

Users had become more and more dependent on OAIS and ODIS. To facilitate detailer trips to the field, a dial-up capability for OAIS and ODIS was implemented. Through the establishment of an 800 number, procurement of lap-top microcomputers and modems with secure calculator

generated passwords, detailers were able to access OAIS and ODIS from the field. This greatly decreased their manual paperwork, impressed constituents in the field and increased constituent confidence in the detailing system.

If a detailer trip was going to the west coast, special arrangements were made through the help desk to have OAIS stay operational longer than the usual downtime of 1800. This delayed backups and batch jobs in the evening, put if planned far enough in advance, could be handled without difficulty or delay in workload.

16. Software Maintenance for OAIS

Maintenance to the older version of OAIS was being done by the DP's in the Application Programming Shop within N470, the Information Systems Development branch, on an as-available basis. This maintenance tasking was to be just until OAIS 1.7 came up. The contractors did not have enough personnel to handle development and maintenance due to the recent contract change.

Most of the changes were maintenance-oriented, with only a few high priority development changes. The change process involved changes to the program but no changes to documentation. The development-oriented changes included giving OAIS the ability to handle the processing of Release from Active Duty (RAD) orders, Resignation orders and Retirement orders. The change for RAD and Resignation

orders occurred in December 1986 and the change for Retirement Orders occurred in March 1987.

These changes increased OAIS's usage. Previous to this, Resignation and Retirement (RAD) orders had to be written manually. The manual process took far too long and chops on the orders were needed from a variety of personnel serving in several different divisions. Personnel in CDR Hazel's division had to type these manual orders. CDR Hazel was always looking for ways to improve OAIS and reduce manual work. He worked closely with the N470 programmers to have OAIS changed to accommodate these two order formats.

With a few small exceptions, all types of orders could now be written on OAIS. Due to the changes made by CDR Hazel, the orders which still had to be typed manually, due to OAIS's inability to handle them, were down to approximately five a day. This is a significant amount when approximately 30,000 sets of orders (basic orders and modifications) were sent out annually. NMPC-2, who is responsible for RAD, Resignation and Retirement orders, was now a full-fledged user of OAIS.

17. ODIS Improvements

During this time, rapid advances and changes were being implemented in ODIS. These changes made the life of assignment and placement officers easier. The ability to get Officer Data Cards (ODC) by social security number from ODIS was implemented in December 1986. Officer Data Cards

carry a condensed version of an officer's personnel history on a single sheet of paper. These ODC's were handy for quick reference and detailing trips. ODIS was able to provide a one to two day turnaround as opposed to requesting the service from NMPC-16 and waiting a week to ten days.

ODIS training and abilities were advertised heavily during this time. Many of the reports and information changes that assignment and placement officers desired and had submitted in the form of Software Change Proposals (which were on hold until implementation of the new version) were available through the database of ODIS. ODIS was not quite as "user friendly" as OAIS. Commands were in an English-like language and knowledge of some boolean algebra was required to operate the database. The Information Center was available for assisting users with ODIS.

Additionally, through ODIS, an electronic mail system was available to all users. The electronic mail system required a separate password, as did ODIS usage. Electronic mail was utilized on a sporadic basis throughout NMPC-4 with some departments taking full advantage of the system and others ignoring it.

18. Contractor Project Management

Throughout July and August of 1986, the contractors tore OAIS apart, broke it down into workable size modules as per LT Hopkins' direction and identified areas requiring work. LT Hopkins allowed the contractor to start from

scratch in fixing bugs and programming/redesigning Navy code.

In September, the contractors requested an OAIS functional expert from the Navy to assist on a daily basis, to make decisions and guide fixes on the reprogrammed version of OAIS. LT Hopkins knew she did not have the expertise to assist the contractors, but at the same time she felt the need to be continually looking over their shoulders.

CDR Griffin wanted CDR Hazel to be this functional expert. CDR Griffin was determined to have OAIS 1.7 work the next time it came up, as his division bore the brunt of user dissatisfaction.

CDR Hazel wanted to be the functional expert assisting the contractors. He had also borne some abuse from the assignment and placement officers for the failure of OAIS in May 1986, being the closest to them due to his previous job as Training Officer. CDR Hazel felt like one of the plank owners of OAIS. He felt he owed it to himself, the department and the users to make it work. CDR Hazel felt he finally had someone on his side in the form of CDR Griffin. Both knew user issues came first and worked towards this end.

CDR Griffin had to take the decision concerning designation of the functional expert to CAPT Williams as CDR Rice did not want CDR Hazel involved. CDR Rice and his

project officers were responsible for liaison with the contractor and wanted to keep it that way. LT Hopkins did not have any objections to CDR Hazel's involvement, she wanted to get back out there with a quality product.

CDR Hazel was designated as the functional expert to assist SAGE. He spent every day of September and October with the contractors. He assisted in the identification of bugs, instructed on fixes and made decisions on functional issues. He was also able to correct minor things which, though of a low-level priority, still bothered him. These included standardizing messages and making error messages understandable to the users instead of being in programmer code. CDR Hazel was on his own. CDR Griffin and LT Perkins occasionally asked him how things were going.

In November 1986, it was announced that OAIS 1.7 would be implemented in March 1987.

The contractors spent most of the fall and winter of 1986 converting OAIS code from JK to 1.7. The code conversion had originally been planned to be a straight line-for-line conversion in view of the design standard of upward compatibility between different versions of APSCOBOL. It was discovered during the preliminary testing of module integration that more than straight line conversion was necessary. Modules had to be completely reworked to conform to the new methods of how the programs were called and how transportation from screen to screen was handled. The new

version of APSCOBOL required more overhead due to the logic changes in the software. Rewriting the logic behind the OAIS screens and programs was time-consuming, but the advantages of more efficient code outweighed the costs involved.

Another major effort was the development of test plans. One of LT Hopkins' directives after the May 1986 failure was the development of test plans. Test plans were written by SAGE personnel and reviewed by Navy personnel. LT Hopkins, CDR Hazel and LT Perkins reviewed the plans for the Navy.

In February 1987, SAGE designated V. Hammer as the new project manager for OAIS. She had previously worked on a contract dealing with the Officer Master File (OMF), so she had some experience with officer systems.

V. Hammer found three major areas needing work when she took over the project. Two of these areas were within OAIS. One was converting the code for all the batch jobs and reports and verifying the Job Control Language (JCL) for each. The second area concerned interface testing with the applications that OAIS provided information to. Of particular concern were the interfaces of the OMF, MFS and OPM.

The OPM was under a different project at SAGE as well as being managed by a separate project officer for the Navy in the Information Systems Development branch, N470.

One person, Mr. Donaldson, was working on the OPM when V. Hammer took over the OAIS project. The majority of work being performed by Mr. Donaldson concerned getting the orders through the Communication Center edits. V. Hammer immediately went to her boss to express her concern over the status of the OPM and its importance to the OAIS project, but to no avail.

V. Hammer set her personnel to working on the changes needed in OAIS reports. She worked on the OMF interface, having knowledge of its workings from her previous project. She got the OMF interface error rate down to about five percent, a much lower figure than the current interface between OAIS and OMF.

19. Conversion Plans

In February, the Navy decided that due to a large amount of user work in OAIS JK, they could not just take OAIS down and replace it with another version without causing undue hardship to the users. A parallel conversion was decided upon and SAGE drew up conversion plans. V. Hammer added some slack time to the estimation of effort it would take to do the conversion in order to give OPM testing more time. Up to this point the OPM had failed every part of the test plan devised for it.

The implementation date for OAIS was moved from March to May 1987.

The reasons behind the push for production of OPM included in-house responsibility for order generation instead of having to rely on NMPC-16, and having officer and enlisted orders in the same format. This would facilitate processing at the Personnel Support Detachments as well as providing orders to military personnel that they could understand.

20. Systems Stress Test

In late February 1987, a systems stress test was planned to test how the newly converted software code worked with the hardware. It was necessary to have users on OAIS, both so the Central Processing Unit (CPU) could have a load and to test the interface between various parts of the new application, particularly those interfacing with the orderwriting module. The test was scheduled from 1500-1530 on a Friday.

Production OAIS was taken off-line during the test. Users were informed by OAIS User Bulletin and given specific instructions on what processes to carry out. User representatives also were informed at an OAIS user meeting. User representatives and OAIS Help Desk personnel were available in the user spaces for assistance and for identification of problems. Since it was a Friday, there was very little participation by the users.

A second stress test was scheduled for a Thursday afternoon. CAPT Williams explicitly requested user

participation at the weekly department head meeting with the Admiral. Procedures were as before, users were notified by OAIS User Bulletin, and user representatives and OAIS Help Desk personnel were in user spaces for assistance. Participation was much better.

21. Pre-implementation

Testing was scheduled to last for six weeks starting in March. Testing was conducted using user representatives and experts on specific portions of OAIS. Testing took place in the training room for several hours each afternoon during the month of April. Washington D.C. experienced a heat wave during this time. It was hot and stuffy within the unventilated training room. The test plans were used as a guide and user representatives verified that menus, screens and procedures worked correctly. Areas that worked correctly were signed off by the users. Test orders were generated and used to test the OPM. CDR Hazel and LT Perkins facilitated the testing along with two of the contractors. LT Hopkins looked in on occasion. TOAIS was of very small size, holding only 100 records, a small number in comparison to the normal 70,000 records of active duty officers. Systems personnel were assigned to monitor TOAIS and unlock problems before they brought the computer system to a standstill. At the end of each session, CDR Hazel prioritized problems identified with the concurrence of LT Perkins and the contractors. Priority categories were: fix

before implementation, fix within a few weeks of implementation and nice to have. OAIS seemed to work fine. The Order Production Module was not quite finished during the test period, but bastardized procedures were available. The only other system interface which was tested during this time with the OMF-OAIS interface. Preliminary tests showed no problems.

During the testing phase, more personnel were assigned at SAGE to work on the OPM. New tests still showed that the OPM did not work. V. Hammer took the issue to her boss once again. She also talked to LT Hopkins and gave her the proof of failure with the completed and unsuccessful test plans. LT Hopkins took the issue to her boss, CDR Rice, who ignored the proof and said bring up OAIS anyway.

22. Training

Some training for user representatives was conducted during these testing sessions by LT Perkins, CDR Hazel and the contractors. Changes to the orderwriting module were promulgated through a new version of the OAIS User Manual. Training on a large scale basis for all users was not possible due to the nonavailability of TOAIS. When testing was not going on, the contractors required use of the TOAIS application to test and implement software fixes to problems identified in prior testing sessions. LT Perkins hoped that once the new version came up, that the individual user representatives would help train the personnel in their

departments if required. The idea of user representatives assisting personnel in their departments was presented during an OAIS user meeting. The personnel manning the OAIS Help Desk were trained through participation in the testing sessions and having some early morning access to TOAIS. Their expertise would be of assistance to users with who are unfamiliar with the new procedures.

LT Hopkins coordinated with LT Perkins to put out a series of OAIS User Bulletins describing some of the new procedures. The plan was to initiate new orders and modifications to old orders on the new version and to use the old version for orders still within the chop chain. To ensure proper usage of the new version, several screens in the old version were disabled. Arrangements were made with Scheduling to have contractor personnel on hand for at least the first week of producing orders to assist the scheduling personnel.

LT Hopkins did not want to bring up OAIS 1.7. There were too many problems with the OAIS-Order Production Module interface. LT Perkins and CDR Hazel also felt that the new version was not ready. They were very familiar with the problems existing with OAIS through their participation in the testing. Even though contractor personnel were working overtime, many fixes to problems discovered during testing had not yet been implemented. CDR Hazel voiced his opinion at a branch head meeting run by CAPT Williams and attended

by the branch heads, CDR Rice, and CDR Griffin. CDR Rice said, "I want OAIS operational before I retire. We have been advertising that it would come up for six months."

23. OAIS 1.7 Changes

The majority of changes revolved around the new orderwriting process and utilization of the OPM instead of AUTONOM. Some of the changes to the orderwriting process included:

- Default setting for mode of transmission changed from message to letter. Orders are designated as administrative message traffic and the decision was made by the Admiral that unless the orders were to be carried out in 30 days, letter was the designated mode of transmittal.

- On-line help with order format. If a user was unsure about what order format to use on a particular set of orders he could fill in just the first digit and get a list of all formats from which to pick. Also if a user was unsure about a particular text to put in a set of orders, he/she could call up all the text and read verbatim what would be printed on the orders.

- Change of text linkers to be more user friendly. Text linkers are used to designate which part of the orders a specific text applies to such as detaching, intermediate or ultimate. In OAIS JK, these linkers were letters with no significance to the user as they were an exact copy of the manual document, the Officer Assignment Document. New linkers possessed some natural linkage to the subject, D was for detaching, and U was for ultimate.

- Change of costing information. If a set of orders was to be modified in OAIS JK, a delta figure (plus or minus) was incorporated in the orders. For a modification in OAIS 1.7 the amount of money was entered without a delta.

- A system was designed to notify a order writer when a UIC included in the orders being written was under minimize. If minimize was in effect, orders had to go by letter, as administrative message traffic was not allowed.

- Incorporation of At or Near Location tables. OAIS automatically calculated if sites for training or the distance between two duty stations were close enough together to be costed as one location. Also the module automatically costed the per diem costs for training, alleviating detailers of this chore.

Changes made to OAIS included the following, some of which had been user requested:

- Query by Name screen. To use OAIS, a person's social security number or Activity UIC was needed. The Query By Name screen allowed an OAIS user to enter the first seven letters of an officer's last name and OAIS would provide a list of matching personnel. The user could then select the one desired.

- Addition of a hold facility to the Action Queue. Quite often, a set of orders is ready to go but either there is no one identified to replace the officer, or there is not enough money to send the orders. Orders that were in a waiting status, caused individual assignment and placement officer's action queues within the chop chain to grow uncontrollable. With the hold facility, a set of orders could be designated a hold and moved off the action queue to a separate hold list.

- Upgrade of Security Access. Users could now have six desk codes identified in their security file, to which they could have access. This access was available without having to log off and log back on again with a different User Id. This upgrade was particularly useful for order verifiers who worked for several assignment officers. Also, when a user went on vacation, access would be available to his/her desk code.

F. CASE STUDY FIVE

1. Background

NMPC-47 was again ready to implement the new version of OAIS with the converted code. The previous try, approximately a year ago, had ended in failure. The past year had been spent converting the code, correcting problems and recoding the orderwriting module. Within the

organization, a transition from a development to a production orientation had taken place. Responsibility for production OAIS had been passed to the Information Systems Support branch and resources were allocated to systems hardware and maintenance.

2. Implementation

The big day came on a Monday. The contractors, LT Hopkins, LT Perkins, and CDR Hazel made the OAIS Help Desk their headquarters as they waited for the calls to come in.

a. Week 1

The first type of problems uncovered had to do with the security access change. Each user was now capable of having access to six desk codes per User Id instead of one. Users had been told of this upcoming change by OAIS User Bulletin as well at OAIS User meetings, but there were people who had not gotten in their paperwork to Configuration Management to change their security profile.

Most of the other problems the first day involved lack of training. Calls came in on how to use or update a screen. The first sets of orders under the new version of OAIS went out by message on Tuesday. There were 13 of them. It was not discovered until after transmittal that instead of having a From of Chief of Naval Personnel, the From was PERSUPPDET Crystal City. The PERSUPPDET Crystal City address had been used in the test orders and had not been changed.

Orders under AUTONOM usually went out approximately 24 hours after costing had approved the orders. During the first weeks of OPM processing, orders were held up for several days due to bad records being passed to the OPM. The philosophy behind OPM development was that the OPM was never wrong. Procedures had to be devised to identify bad records on the first run of the OPM, eliminate them and rerun the OPM until there were no bad records. This took up an increasing amount of each night's processing time. Occasionally, work was not accomplished before it was time to bring OAIS up in the morning.

The following problems caused inconvenience to the users and needed a solution:

- A problem generated by the conversion process made 95 sets of orders that had actually errored out of AUTONOM and that were AUTONOM rejects look like they had processed successfully. There was no way to correct these orders in either version for a few days.
- Several of the changes implemented in OAIS JK were not included in the new version.
- Automatic chop chain routing of orders to coordinator review and subspeciality when the orders did not require the edit.
- Every set of orders required transferring through the Minimize screen within the order writing menu, even when the UICs were not under minimize.

Due to the orders going out with incorrect addressees, CDR Griffin required that each day's orders had to be reviewed prior to release. LT Perkins and CDR Hazel were designated as the reviewers. Through this review process, a major problem was discovered with aviation duty

wording. The aviation duty wording determines flying status and pay of aviation personnel. Orders were going out with incorrect flying status determination. Looking for a fix for this held orders up for three days.

A Communication Center procedure that had to be kept in mind when holding up orders was that the Date-Time-Group (DTG) on the orders could not be more than seven days old.

CDR Hazel and V. Hammer finally located the cause of the aviation duty wording error by going through the code line by line. CDR Hazel, being a functional expert on order specifics, was able to tell V. Hammer what was to print and V. Hammer was able to identify the errors in the code.

The first week of OAIS 1.7 ended. All personnel, contractors and Navy, had worked long hours and were exhausted, but the new version of OAIS had stayed up for a whole week, which was better than the last time. LT Hopkins went on leave for three weeks. Her boyfriend was coming back from a six month deployment on-board a ship.

b. Week 2

More problems developed with orders on the second week.

- One hundred thirty sets of separation orders were sent out to personnel that were not due to separate from the Navy.
- Duplicate DTG's were discovered. This was in violation of Communication Center procedure.

- Missing DTG's were discovered in the course of routing hard copy orders back to the originating assignment officer. OAIS showed that some orders went out on particular personnel with an assigned DTG, but no hard copy was ever found. Discovery of this problem changed the procedures involved in routing of hard copy orders.

Previously, Order Support branch personnel had just sorted orders, keeping a copy for in-house records. Now they were required to verify against a DTG log actual receipt of hard copy orders. Missing orders were passed to LT Perkins who had been delegated liaison with the Communication Center.

Along with ownership of the OPM came responsibility for bad magnetic tapes. Tapes that could not be read by the Communication Center were returned to Scheduling and the back-up tape submitted. Occasionally part of a tape was transmitted and in order not to retransmit messages, a violation of Communication Center policy, a copy of the partial tape had to be made by contractor personnel.

The order verification process was made even more difficult by the poor quality of reports provided to the OAIS Help Desk. The report formats were just copies of the old reports from when AUTONOM and NMPC-16 were responsible for order tracking and verification. Now that NMPC-47 had full responsibility, more information was needed to fulfill this job.

The change in the default value of the orderwriter to letter versus message caused a steep increase

in the number of orders that went out by letter. The sorting machine was quite old and acted up on occasion. With an increase in workload, the machine broke down at least once a day causing a letter backup. Letters had to be sorted manually on many a day by already-overworked personnel.

From the first try at generating a MFS tape there were problems. It took about a week of working things out between NMPC 16 and Naval Finance Center in Cleveland. It wasn't until about two weeks into order production that the accounting problems with orders were discovered. These problems included:

- incorrect rank on the accounting line.
- missing accounting lines for training segments of orders.
- incorrect report not later than, report no earlier than dates.
- accounting data for training was printing on orders not requiring it.
- incorrect information in the at or near location tables.

Messages and questions started coming in from the fleet concerning orders. There was missing activity text for certain Personnel Support Detachments, and misleading text for some orders. The Communication Center also identified problems pertaining to the Standard Subject Identification Code (SSIC) used on orders messages and the use of asterisks to separate portions of the messages.

These discrepancies were pointed out by Communication Centers in the field.

The Communication Center threatened to discontinue service to NMPC-47 on several occasions, but that threat became real when messages were transmitted starting with Date-Time-Groups having 26 as the time. The DTG goes on a 24 hour clock and there is no such thing as an hour 26.

Minor inconveniences included several reports that were not printing and the Navy Times tape not being printed. The Navy Times tape became quite an issue as Navy Times said a lot of their readership was due to the orders published in Navy Times. Contractor time needed to correct order problems was diverted to the Navy Times issue.

During the second week of crisis, CDR Hazel and LT Perkins were appointed project officers in LT Hopkins' absence. CDR Hazel dealt with OPM fixes and telling the contractor what to do as they were of first priority. LT Perkins dealt with production issues such as liaison with Scheduling, Communication Center, order production, and fixing OAIS problems. Upper management instituted thrice weekly status meetings with SAGE, CDR Griffin, LCDR Wall, LT Perkins, CDR Hazel, and some of the technical personnel from both SAGE and NMPC-47.

G. CASE STUDY SIX

1. Background

NMPC-47 is still in a crisis mode due to the numerous problems with OAIS 1.7. OAIS has stayed operational, but at the expense of resources, primarily contractor overtime and NMPC-47 personnel.

2. Aftermath of May Failure

Day-to-day operations revolved around daily order production and retransmittal of orders if necessary. Once a day's order status (orders were or were not produced) was known, work could continue on fixing trouble reports for OPM and OAIS. The number of manual orders having to be typed by Order Support branch personnel increased from a daily average of five to 75. There was a constant backlog.

This crisis mode continued through the summer. LT Hopkins returned from leave and was told she was not to get involved with the production-oriented part of OAIS. In July, SAGE lost the OAIS contract to another contractor, SYSCON.

3. New Contractor

SYSCON took over as contractor for OAIS in August. SYSCON was familiar with the workings of NMPC as they were the contractor for two other applications within NMPDS. Arrangements were made for the turnover of source libraries and system documentation to SYSCON. NMPC-47 acted as

intermediary, as there were hard feelings on the part of SAGE personnel.

SAGE personnel involved with the OAIS project felt quite bitter. They had worked overtime all summer without any breaks. Blame had been placed at their feet and everyone was calling OAIS a disaster when, in reality, OAIS was fine; it was the OPM-OAIS interface that did not work. Work on OAIS and OPM trouble reports virtually came to a standstill during the months of July and August.

LT Perkins trained the SYSCON personnel on the functional purposes of OAIS and exposed them to the language of the assignment and placement officers.

SYSCON did an initial examination of the order generation problems. At the time they saw no way around the quick and dirty fixes implemented by SAGE, but planned for their demise in the near future. The thoughts of NMPC-47 management were those of starting over with a fresh attitude and management style. CDR Griffin, CDR Hazel and LT Perkins were impressed with the experience that Ms. Green, the project manager at SYSCON, brought to OAIS. Initial meetings with her consisted of honest and in-depth explanations for OAIS problems. These things had not been forthcoming from SAGE personnel. Three SYSCON personnel were assigned to rotate staying with Scheduling to get orders out each night.

4. Personnel

LT Hopkins was moved to another project officer job. A junior LT, LT Sanders was promoted from within the Surface Department to become the OAIS Project Officer. LT Sanders had a user's knowledge of OAIS, but did not have a computer or software development background.

LT Perkins and CDR Hazel were still in charge of OPM and production OAIS issues, but LT Sanders was to get the development side of OAIS on the move again.

CAPT Hampton relieved CAPT Williams in September 1987.

5. Organization Changes

Several changes were made to the structure of the organization after CAPT Hampton arrived. Order Support was moved from the Order Support branch to the Information Systems Support branch. Scheduling was moved out of Systems Administration due to its increasingly important part of everyday happenings. The Information Systems Support branch, N471, was now completely customer service and production-oriented. A new division was created out of N472 and was called Information Systems Policy and Procedures. It included Configuration Management which was moved out of N471 and Data Administration which was moved out of N470. See Figure 5.

Another change implemented by CAPT Hampton was that training was mandatory for new assignment and placement

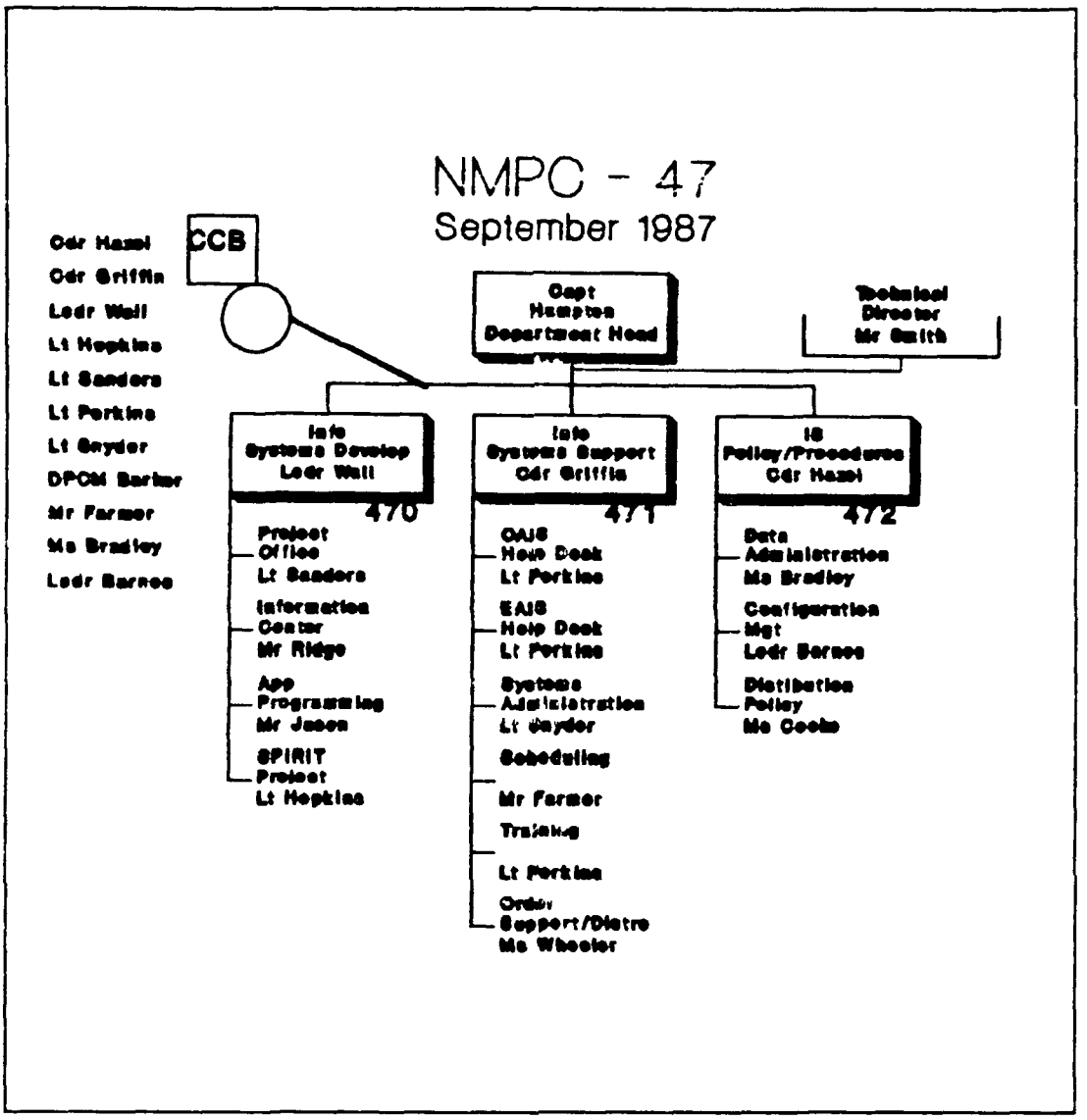


Figure 5. NMPC-47 Organization, September 1987

officers. By this time, there were two modules of OAIS and one for ODIS of computer-aided training developed by Oak Ridge Associated Universities. The computer-aided training utilized an IBM PC XT computer, a Pioneer Laser Disk and an ATI touch screen. Training was provided using voice

synthesis and touch screen technology that was interactive and user friendly.

OAIS user meetings became mandatory under the direction of CAPT Hampton. Any user representative not in attendance was written down as absent in the weekly user representative meeting minutes. The minutes of each meeting were published as dictated by CAPT Hampton.

6. Naval Audit

NMPC-47 received notification of a pending Naval Audit concerning wasted paper due to unused and unwanted OAIS reports.

7. OAIS Development versus OAIS Production

The initial division of labor at SYSCON was three contractors working on production trouble reports with LT Perkins in charge and three contractors working on development and necessary changes with LT Sanders in charge.

Two of these necessary changes were the addition of several data elements to the Activity File, one of the major applications OAIS interfaces with and implementation of the Joint Specialty Designation and its associated tracking/ chopping of orders which had been approved by Congress.

These changes to the Activity File by EPMAC also involved moving the location of several data elements within the file. Plans were made for the change. SYSCON and LT Sanders spent an entire weekend of computer and contractor time trying to implement the change without success. LT

Perkins was not included in their plans even though she was an expert on OAIS. After the unsuccessful weekend, CDR Griffin and LCDR Wall decided to put off any development changes for several months. They decided that LT Sanders needed to learn more about OAIS and NMPC-47 operations.

A problem uncovered during the implementation of this change was the inadequate and old OAIS documentation. One of the reasons there were problems with the implementation was because the documentation was incorrect.

LT Perkins was in charge of all OAIS production-oriented work and had all six programmers working on production changes. CDR Griffin and LCDR Wall hoped that with all the time spent on production problems that some progress on long standing OAIS problems could be made. Of particular importance was the problem with the PRD data element. Assignment officers would update an officer's PRD and due to problems with the Officer Master File interface, the change would not reflect in the Officer Master File and the PRD would change back to its previous value in OAIS.

8. Production Changes

Plans were made and progress continued toward having the Navy personnel in Scheduling be the ones running the batch updates and order generation at night.

A policy was implemented by CDR Griffin that whenever a fix was put into OPM or OAIS, a SYSCON person

would be in Scheduling that evening to ensure that no problems were encountered.

Another change was that all trouble reports were prioritized by LT Perkins. LT Perkins maintained a daily status of the progress made on individual trouble reports. User representatives were kept informed by weekly, mandatory OAIS meetings.

LT Perkins instigated a policy of having the Navy test all software fixes generated by SYSCON. LT Perkins delegated most of the testing to her personnel at the OAIS Help Desk. Involving the help desk personnel in the testing and scheduling of software changes increased their morale. If it was a top priority trouble report she would also test the fix herself.

LT Perkins preferred to implement the OAIS changes in the afternoon, preferably on a Wednesday or Thursday, so that the change would be available first thing in the morning. User representatives were informed of the implementation schedule at the weekly meetings. If a problem was discovered with the fix, it could be pulled out with only an hour of downtime. Thursdays and Fridays were usually slow for the users as the majority of their workload was accomplished in the early part of the week. These days also were slow days for Scheduling. They were usually caught up on batch jobs and had some spare time, which was needed in case a problem arose.

With Scheduling of more importance, several problems came to the forefront. Actually they had been problems for a long time, but never made it to the limelight. These included problems with non-standard run books and program naming conventions. The solutions were worked out with the Configuration Control Board (CCB), Configuration Management and SYSCON. These standards would be incorporated in any new development or software fix. The CCB also decided that a period of review prior to implementation of a fix to ensure compliance with run book and adherence to standards would be implemented.

Report distribution problems were also noticed. With the OAIS 1.7 implementation, several reports were not printing, some reports were printing incorrect information and there were now unwanted reports requested by personnel who had left NMPC. Report trouble reports had been given low priority during the summer, but with a Naval Audit being conducted, one of the junior programmers at SYSCON was assigned to fix all the report trouble reports.

CDR Hazel instituted a new policy with respect to trouble reports for the OPM. He required a requirements analysis be completed prior to submission of a trouble report to the contractors. This analysis would assist in establishing OPM documentation.

9. OAIS User Participation

For those trouble reports not identified as top priority, user representative input was taken on where they should fall in the priority scheme. LT Sanders was getting the paperwork side of the OAIS development in order. She collected approximately 200 SCP's that had been submitted over the past three years. Records had not been maintained very well and she was not sure if some of the changes had already been implemented. User representatives were asked to vote on the priority of SCP's for development. When a software fix to OAIS involved a specific procedure for a group of users, the applicable users would be asked to test the fix before it went into production.

10. NMPDS Planning/Integration

A Configuration Control Board (CCB) was established in NMPC-47. Members included branch heads, Data Administration, Configuration Management, Systems Administration, Scheduling, project officers and help desk personnel. The purpose of the CCB was to review plans and changes to all four applications under the NMPDS umbrella. The plan was to ensure compatibility of all the applications under NMPDS for future integration and resource sharing. All software fixes and a plan for implementing the fix were routed around to various members of the CCB for signoff before the weekly scheduled meeting.

At the weekly scheduled meeting, the initiator of the trouble report, usually LT Perkins, briefed the board members as necessary and advised them on the schedule for implementation. SYSCON was also invited to CCB's on an as-required basis. Their role was usually to explain a long range plan for correction of a problem.

11. Electronic Mail Usage

CAPT Hampton believed in the electronic mail system. He ensured command usage of electronic mail within NMPC-47 by sending out all his messages to the branch heads on it. With top-down support, the branch heads implemented electronic mail into their routines. Usage traveled further down the chain of command until every manager made sure they read their mail everyday.

By late November, the major problems with the OPM were solved. The quick and dirty programs were still in place because replacements for them were quite involved. Some development efforts were started. OAIS users had settled down having seen affirmative action and improvements with new procedures.

IV. ANALYSIS

A. INTRODUCTION

This chapter analyzes each of the six case studies. Section One contains questions which can be used for two purposes: to help a student prepare the case or to lead off questions for a class discussion. Section Two is a summary of the case study. Section Three lists the major issues or problems that the case study deals with. Identification of these issues links potential lecture material with the case. Section IV is the case analysis in which theories pertinent to the case are discussed and the particular facts of the case are related to the theory.

One specific area of analysis which will be included in all six cases is Nolan's Stages of Growth Model [Ref. 11:pp. 672-673]. Nolan has researched information systems development throughout many organizations. His research involved the monitoring of information systems investments, information systems budgets, types of applications being developed, and the degree of management control and planning utilized. By looking at these factors he noticed definite shifts in the direction and growth of the information systems. He developed a model covering six stages of growth of both the information systems and the management of the information systems. Not every organization or information

system passes through all of these phases, but they are a good indication of possible directions for the future. This model can assist an information systems department to evaluate its present and future decisions in comparison with basic indicators of growth. See Figure 6. Throughout the case series, the stage or stages that NMPC-47 is in will be identified and discussed. [Ref. 11:pp. 672-673]

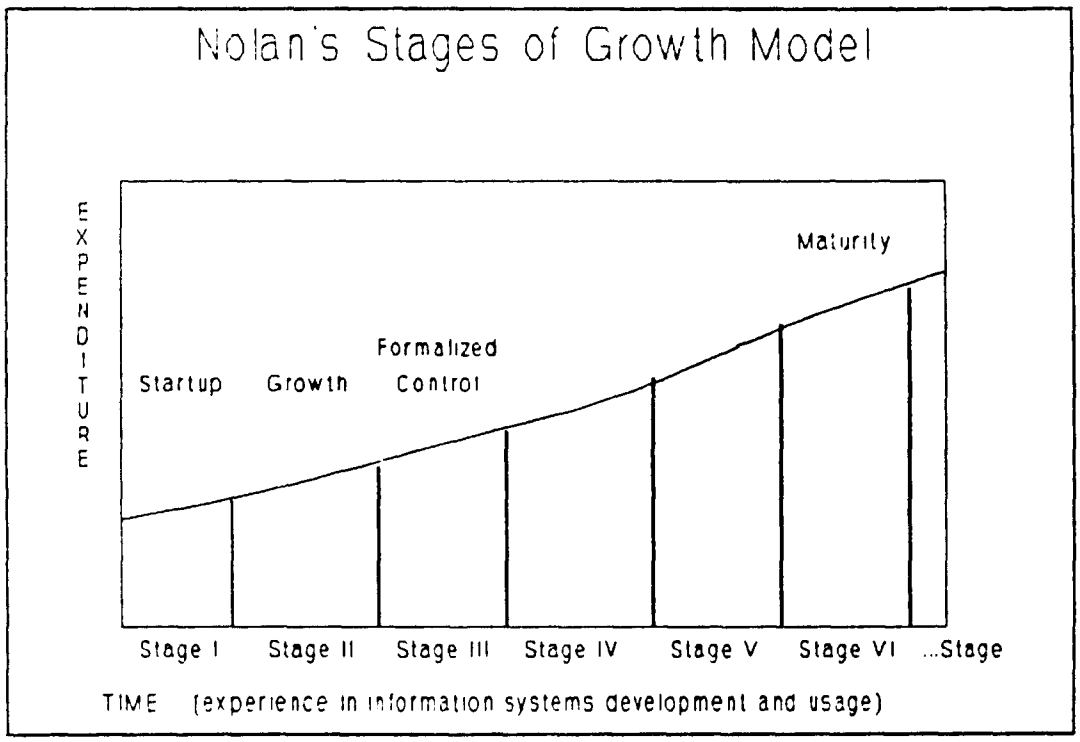


Figure 6. Nolan's Stages of Growth Model

B. CASE STUDY ONE TEACHING NOTE

1. Questions

- What problems do you anticipate with the development and implementation of the management information system?
- What was done well in the development and implementation?
- What affects do you think implementation of the prototype will have on the Life Cycle Management of OAIS?

2. Case Summary

This part of the case series provides the background concerning the establishment of the Officer Assignment Information System (OAIS). Descriptions of the users, user requirements, command mission, and OAIS requirements are discussed. The development methodology chosen for OAIS development was prototyping. The software utilized was Application Productivity System (APS)COBOL, a third generation language. NMPC-47 was on the leading edge of technology by utilizing prototyping versus the traditional development approach. The initial deployment of OAIS, the problems encountered throughout the user organization, and the improvements OAIS made in a previously manual assignment process are described.

3. Major Issues/Problems

- Use of prototyping development methodology and a new generation of software.
- Deployment of the prototype due to user dependence.
- Poor documentation.

- Lack of pre-implementation activities for the application and the effects on the users.

4. Case Analysis

a. Nolan's Stages of Growth

Stage one is called Start Up. This stage begins with the first computer acquisition of an organization. In this stage the computer is being utilized for general and administrative projects whose automation would result in cost savings. There is quite a bit of change; change in jobs and working habits and fear of the unknown. [Ref. 11:p. 672]

NMPC-47 has just entered the Start Up stage. The assignment process is one of an administrative nature. The first computer has not even been procured and a leasing arrangement is providing the computing power. Personnel within the computer organization who are used to manual methods and potential users of the system are resisting the change and fearing the unknown.

b. Prototyping Methodology

Prototyping is a development methodology that enables the developer of a computer application to create a working model of the software to be built [Ref. 12:p. 22]. Prototyping is used in cases where the speed of implementation of the computer application is of the essence and/or where the users are unable to specify explicitly what they want the system to do. Good potential computer application candidates for use of the prototyping methodology include:

those where the user is concerned about screen format, where the system will be on-line, where there are very few algorithmic details, and the system utilization is for ad hoc retrieval or record management [Ref. 13:p. 61]. The prototyping takes the place of requirements definition in the traditional classical project life cycle development methodology.

The prototyping steps are as follows: (1) identify the user's known information requirements; (2) develop a working model; (3) have the users use the system in a "hand's on" manner and note user requests for changes; and (4) refine or expand user requirements through development of another model [Ref. 11:p. 612]. This process is iterative and continues until the user is satisfied with the working prototype. Not only does the user clarify his requirements for the computer application, but the developer of the system also receives a clearer picture of what needs to be done [Ref. 12:p. 23]. One problem that has been identified with prototyping is the tendency of users to accept a premature prototype. A major factor contributing to this is dissatisfaction with the current system [Ref. 14:p. 2].

The assumption within the prototyping methodology is that once the users are satisfied with the prototype, the model will be thrown away and replaced with real programs by following the design, code, test and

implementation steps of the traditional development methodology [Ref. 13:p. 61]. The reasons for throwing away the working model are as follows: The emphasis of the prototyping method is on the output, not how the output is produced [Ref. 11:p. 612]. This emphasis on the output combined with the fact that the developer is working under a time constraint leads to the possibility of compromises in the implementation of the inner workings of the model. Such things as error recovery, audit trails, backup/restart facilities, user and system documentation and conversion procedures may be glossed over [Ref. 13:p. 62]. An inefficient algorithm may be incorporated or an inappropriate operating system may be utilized all in the interest of time and output [Ref. 12:p. 23]. Factors which affect the life cycle of the computer system such as overall software quality, and long term maintainablilty may not be considered [Ref. 12:p. 23].

The decision to use the prototyping methodology at NMPC was an excellent one. Problems with the manual assignment process had been discussed for several years. Of particular significance was the amount of time it took to process an individual officer's assignment. Each assignment took approximately four to five weeks to get approval. The assignment then had to be manually costed and typed before transmission to the officer. Other problems included officer information existing in different files within

different computer systems in NMPC-16, accuracy of the data, inaccurate reporting instructions on moves, and inability to consider a large pool of possible assignments. Since the users were a diverse group, with the manual assignment process being adapted differently for each department (Aviation, Submarine, and Surface), NMPC-47 was unsure exactly what the user requirements were. Additionally, due to the timeframe of development, the early 1980's, problems with the traditional life cycle development were coming to light. Cost overruns, schedule delays, and computer systems not meeting user requirements characterized the current state of the industry. The prototype was developed and users from the Surface Department helped refine the working model.

c. Selection of Software

APSCOBOL, a product still under development, was chosen as the software for OAIS. The Application Productivity System portion consisted of an application generation tool which would interface well with the prototyping methodology. Application generators are software programs that permit specification of an entire application at a high level without having to be concerned with the coding of each line of code. The application generator produces the source code based upon the specifications [Ref. 11:p. 254]. It can also allow a junior programmer to produce sophisticated code after just a few

weeks of training. Other tools included a screen painter and report generator. A screen painter allows easier configuration of a data formatted screen. Additional benefits are ease of change and proper spacing for ease of use. A report generator assists the extraction of data for reports from specific files. These tools can speed up the production of code.

Of particular importance to NMPC and the prototyping methodology was the portability of APSCOBOL between different types of hardware. By using APSCOBOL, a prototype could be developed during the hardware procurement process with the knowledge that whatever hardware was purchased, the prototype would be able to function on it. There was definite risk taken by NMPC by using the first version of APSCOBOL. It is a notorious fact that the original version of most any piece of software contains bugs and it is safer to wait for the next version, where the bugs have been corrected.

d. Deployment of the Prototype

The prototype vastly improved the assignment process. Users became so dependent on the system that when it was time for the developers to take the working model and finish the rest of the development steps, NMPC-47 management gave into user pressure for immediate implementation of OAIS.

The tendency to implement the prototype is a strong and dangerous one [Ref. 13:p. 63]. Problems that this will cause cover both the immediate and long term life cycle management activities. Recall that prototype emphasis is on the output, not the internal workings of the system. Inefficient algorithms, error handling procedures, inadequate interfaces with other systems, and poor user documentation are a few of the possible immediate problems. In the long term, maintenance and modification of the system will be difficult. Inefficient use of computer resources will come into play, incomplete system documentation will make incorporation of changes frustrating and the changes will take a longer period of time [Ref. 14:p. 2]. Of particular note are changes desired by the second generation of users [Ref. 13:p. 63]. Second generation users are those users not around to see the vast difference between the manual system and the automated system. Changes requested by these users will most likely be handled by second generation developers who are not as familiar with the code and appropriate reasons for handling certain situations as they are.

To guard against implementation of the prototype, project management should state at the start of the project what the development procedures will be [Ref. 14:p. 2]. By providing this guideline and educating the users as to the benefits of proper design, test and

implementation, a better computer system, in both the short and long term, is possible.

Problems with implementation of the prototype first became evident as OAIS was implemented in the Aviation and Submarine Departments. The lack of user documentation caused OAIS utilization problems. Training is an integral part of the implementation procedures for a computer application. Users that are not prepared beforehand with training and user documentation are soon frustrated and often times do not use the application. There had been no problem with OAIS within the Surface Department due to their working knowledge of the system which was acquired during their assistance with development. A training officer billet was established and filled in the summer of 1984. The first user's manual was produced in January 1985, over two years after the implementation of the prototype.

e. Poor Documentation

One of the problems caused by implementation of the prototype is the poor quality or lack of documentation. The following has been noted from a report prepared by SYSCON corporation concerning documentation efforts in prototyping efforts:

> ...formal written documentation takes a poor second to the exciting, more visual simulation of new prototype software. Often, by the time it is understood how badly good, careful documentation is needed, the people who could write it best are gone. [Ref. 15:p. 5]

> Without documented requirements, interpretation replaces detailed definition. Developers interpret users' stated

> requirements. Subsequent modification to functionality is interpreted by new users' in relation to the operating software system. The process moves ever further from objective to subjective. [Ref. 15:p. 5]

The lack of user documentation and its effects have already been discussed. Modifications and enhancements have not occurred to OAIS yet, but it is fairly safe to predict that problems will occur due to a lack of system documentation and updated system requirements.

f. Suggested Pre-Implementation Activities

Any change within an organization needs to be planned for and managed closely. Individuals resist change for a variety of reasons. These reasons include fear of the unknown, avoidance of uncertainty, additional pressures and loss of individual security [Ref. 9:p. 37]. Past ways of doing business, daily habits and routines are a part of an individual's security because they are predictable. There is a loss of the prior "comfort zone," which contributes to an individual's sense of values and view of themselves [Ref. 9: p. 163].

Two criteria are recommended for minimizing resistance to change. These are education of personnel and user participation in the planning and decision process [Ref. 16:pp. 94-95]. Education of personnel establishes effective lines of communication and decreases speculation and rumors. The longer personnel have to speculate about an upcoming change, without being provided official information, the more likely it is that resistance will

emerge [Ref. 9:p. 163]. Having open lines of communication gives personnel someone to go to with questions and concerns. Education provided to individuals should include schedules, plans, both short and long term, and their probable consequences [Ref. 16:pp. 94-95].

It is more likely that acceptance of the change, as well as an assurance of the application meeting user needs, will be accomplished by involving personnel in the planning process. Personnel that are involved are more likely to display interest and feel a sense of ownership. This is likely to lead to increased motivation and understanding [Ref. 9:p. 163]. Additionally, in a sense, management has added people to its point of view for the need and understanding for change. Personnel involved with the change can spread good information, not rumor, among fellow workers.

In addition to education of users, all levels of management should be made aware of the upcoming changes [Ref. 16:p. 132]. This awareness will increase both support of the new idea and perhaps bring out possible loopholes missed up to this point. With all management levels speaking the party line and understanding the reasons for change, increased acceptance will be the benefit.

An organization is composed of flows of information, personnel and material [Ref. 9:p. 29]. The implementation of OAIS affected all three of these factors.

The flow of information went from manual to automated. The personnel interacted with throughout the course of a business day changed as well as how the material was produced. Different material was also produced. Automated reports, one of the outputs of OAIS, were now sources of information.

Taking into consideration the two criteria useful in minimizing resistance to change; there was participation of some users (all from the Surface Department) in the decision making and modeling of the prototype, but no education of current or future users. This participation in the prototyping process did foster a sense of ownership and additional motivation within the users. Training was not necessary for these personnel. This first implementation in the Surface Department set a bad precedent for NMPC-47 management and created a false sense of security.

It was not until basic problems with using OAIS were discovered upon subsequent implementations that management realized education of users was a necessity. In addition, the lack of education for the personnel in the Information Systems Support branch and Order Support branch concerning the department's changing direction was a deterrent to acceptance of change. Information Systems Support branch personnel were busy maintaining the current manually-oriented systems. They were not consulted on the

details of the new systems, nor invited to meetings. These were the people familiar with the systems which would interface with OAIS as well as those with the intimate knowledge on order writing, the primary objective of OAIS. Without their support and indeed the criticism they heaped on OAIS, the resistance of the users who still interfaced with these personnel grew.

After implementation of OAIS, many users continued in their manual-oriented routine patterns of decision making, order verification and interface with personnel in the assignment process chop chain. If top management within the division such as the Submarine Department, took an active interest, it was more likely that OAIS use replaced some manual work. One user had not even turned the computer on. It was not until individual attention was paid to each person or group, that grudging acceptance came. "Tender loving care" was called for to get past the resistance and onto understanding and comfort with OAIS. This was accomplished by establishment of a training officer billet. Establishment of this function was a reaction instead of a planned event. If training of users had been planned upfront along with the software development and hardware procurement, OAIS acceptance would have happened much quicker within the command.

C. CASE STUDY TWO TEACHING NOTE

1. Questions

- Does project management work well with this organization structure? Why or why not? What changes would you recommend?
- Are you satisfied with LT Hopkins' management of the OAIS project?
- Is the new version of OAIS going to work properly? Why or why not?

2. Case Summary

This case addresses the timeframe of October 1985 through May 1986 for activities within NMPC-47. A new project officer for OAIS has just taken over the project. Personnel changes are also taking place within the contractor's OAIS project staff. The primary activity during this time is development of a new version of OAIS. The major changes involved are conversion of the software from the original version of APSCOBOL to a new version, 1.7, and a newly designed orderwriting module. The team of personnel responsible for this new version is a combination of contractor and Navy Data Processing Technicians.

3. Major Issues/Problems

- Implementation of matrix structure on organization.
- New project officer and project officer style of management.
- Heavy reliance on contractors.
- OAIS development team combination of contractor and Navy personnel.
- Lack of planning for pre-implementation activities.

4. Case Analysis

a. Nolan's Stages of Growth

NMPC-47 has moved up the growth curve with its evolving computer application. The changes to OAIS put NMPC in the Growth of Information Systems stage. Characteristics of this stage are having the excess computer capacity characteristic of the Start Up phase being used up quickly, and making investments in additional hardware and software. This contagious enthusiasm of users and computer personnel results in uncontrolled growth. OAIS users have become somewhat sophisticated in usage of the application and have requested enhancements. The Systems Administration division has just received its first computer and additional peripheral equipment is on the way. [Ref. 11:pp. 672-673]

b. Project Management

Project Management is an ongoing process throughout the life cycle of a computer application by which a team leader (project officer) directs the team in the development of an acceptable system which meets user requirements and that is produced within the allotted time and budget constraints [Ref. 17:p. 161]. Directing the team involves using the basic management functions of planning, organizing, directing and controlling. The key concept underlying project management is that the project officer is the single point of integrative responsibility between all project team members [Ref. 18:p. 4].

In the OAIS project, the development team would consist of the contractors, the Navy Data Processing Technicians in the Application Programming Shop, the Training Officer in N470, and the various functional managers such as Systems Administration, Data Administration and Configuration Management. The integration of all of these faction's efforts towards development of a new version of OAIS is LT Hopkins' primary task.

Project Officers' view project management as "a source of considerable frustration in attempting to execute their responsibilities in the face of inadequate authority, misunderstanding, skepticism and even hostile attitudes." [Ref. 18:p. 17] Frustration results from having to coordinate various activities with personnel on several levels within the organization and needing to give effective direction to personnel that do not report to them in the formal chain of command [Ref. 18:p. 34]. Within NMPC-47, project management operates in an organization structured as a matrix. Resources and taskings go across traditional organizational lines and the personnel tasked are working for two bosses, LT Hopkins, the project officer and their functional manager.

c. Matrix Management

Using a matrix structure is the preferred arrangement when the following three basic conditions exist simultaneously within an organization: (1) outside pressure

for dual focus; (2) pressures for high information processing capacity; and (3) pressures for shared resources. A dual focus refers to a situation where two issues are critical to the organization's survival. In the case of NMPC-47, the dual focus is for development of OAIS and the continued manual maintenance of functions required by assignment and placement personnel. Neither function can be allowed to overrule the other as they are both critical to the continued fulfillment of the organization's mission. A balance of power must be maintained between the two areas and each issue must be addressed during decision making especially decisions dealing with costs, schedules, and personnel. Having pressures for a high information processing capacity are the result of relatively unstable and unpredictable demands on the organization. This unstable condition dictates the need for additional information processing. The unstable condition in conjunction with unknown future events, such as technological advances, environmental rulings and government regulations, requires consultation with many members in the organization. These additional personnel involved in decisions increase the complexity of the decision making and increase the requirement for additional information processing. NMPC-47 is in an unstable condition. OAIS has been developed by contractors and implemented for 330 users. The Information Systems Support branch, N471, has just

received its first computer and OAIS has transferred from the leased machine to the hardware in-house. The first major change to OAIS, software conversion and enhancement to the orderwriting module, is underway. NMPC-47 is dealing with changes in technology as well as supporting 330 OAIS users and implementing a major change. The expertise of many personnel located throughout the department is needed in the decision making process to ensure the continued smooth operation of OAIS and the development of the OAIS enhancement. The third condition for a matrix structure is pressures for shared resources. By sharing resources, economies of scale are achieved, scarce resources are available and costs can be decreased. For NMPC-47, the resources consist of human and computer resources. Of particular concern are the technically proficient personnel in the Information Systems Support branch, whose expertise is needed for assistance with the OAIS enhancement. The expertise of the Order Support branch personnel concerning the requirements of officer orders is also needed during the design of the orderwriting module. [Ref. 19:pp. 13-18]

There are advantages and disadvantages to a matrix structure. Besides assisting with the above three conditions, a matrix structure can also create opportunities. There is the opportunity for growth in individual knowledge and skills that is not possible in the traditional organization structure [Ref. 19:p. 103]. With

the increase in complexity and personnel involved in decision making comes increased amounts and patterns of contact between individuals [Ref. 19:p. 104]. This increased contact increases the requirement for communication. Communicating with the necessary personnel takes additional time and enhanced communication skills. Conflicts between individuals are certain to arise. Conflicts can be looked at from a positive viewpoint. If all the personnel involved in a conflict air their opinions and the assumption is that everyone is working for the common good of the project, then it may be possible to arrive at the best solution to a problem [Ref. 19:p. 104].

A decision can not just be made one day to transition to a matrix structure and the next day do it and achieve success. The process of the transition doesn't just involve changes to the organization chart. Changes are also required in the systems, culture and behavioral patterns of the personnel involved. The success of a matrix is dependent on the organization helping the personnel to understand and function in new ways [Ref. 19:p. 103]. For the most part, people are brought up in the "one person-one boss" tradition. Switching over to being responsible to two bosses often involves stress and uncertainty due to the possibilities of conflicting interests and loyalty to functional responsibilities [Ref. 19:p. 18].

In this case study, NMPC-47 had just made the switch to the matrix structure. The time was not taken to educate personnel, management or to prepare the organization for the change. Development concerns had top priority. A matrix organization for accomplishment of OAIS project management was the means to the end. If the time had been taken to educate those involved, establish procedures and standards, many of the problems, primarily those concerning conflicts, could have been diminished. Conflicts in computer system project management can be generated from the following: project priorities, administrative procedures, technical opinions, performance trade-off decisions, utilization of manpower resources, cost, schedules, personality and intensity of work required according to the phase of the life cycle that the project is in [Ref. 18:p. 46].

Conflict can be minimized by the managerial behavior of the project officer. Managerial behavior concerns approaching functional managers with flexibility, understanding of both sides of an issue and by avoiding absolute statements of requirements [Ref. 19:p. 51]. Project officers must rely heavily upon their interpersonal, group management, and communication skills to influence people to do what is essential for project success. When project officers are dealing with their peers within an organization, Stanley Davis and Paul Lawrence suggest that

they determine how the other person operates and with this knowledge establish an individual relationship with each of the different personnel on the project [Ref. 19:p. 88].

In particular, for development of a computer application, the three areas most likely to cause conflicts are priorities, manpower resources and schedules [Ref. 18:p. 53]. Each of the functional managers has his/her own schedules, priorities and workload which must be fulfilled. It is a given that the original plans and schedule will change as the project is developed. Each computer project will be different, will be developed by a different team of personnel and, in particular, the unexpected can occur when dealing with new technology. By keeping personnel involved with the project as up to date as possible, the project officer can lessen the surprises and crisis situations which lead to conflicts.

In addition to managerial behavior, the establishment of interpersonal influence bases are helpful to a project officer in performing his/her job. Three influence bases suggested by Russell D. Archibald are: (1) reward and punishment power; (2) expert power; and (3) referent power. Reward and punishment power involves having the power to either block or facilitate the attainment of personnel or career goals of the people working on the project. Expert power refers to the expertise of the project officer concerning the specific topic or project.

Expert power is conferred on the project officer if the personnel feel he/she has greater expertise than they do in the subject matter or that he/she is more qualified to make decisions than they. Referent power is when the personnel are personally attracted to the project officer and value that relationship and the project officer's opinion of them.

> Personal friendships and alliances can become an important source of influence for a project manager. If a project manager is personally disliked, he many have negative referent power, which will make the task of influencing the project contributors even more difficult. [Ref. 18:pp. 45, 44-45]

d. LT Hopkins' Management

LT Hopkins did not integrate the efforts of the project team members in the project. Functional managers and team personnel continued on with their functional responsibilities, but there was no team effort working on making the OAIS project a success. For example, personnel in the Information Systems Support branch, N471, where the Systems Administration and Configuration Management functions are located, were not invited to meetings nor consulted or apprised of OAIS plans. The Training Officer was also not involved in the development of OAIS. Changes being made to OAIS were of particular importance to the Training Officer, but this information was not available until a month before implementation of the new system. The most significant lack of coordination occurred with the combination Navy and contractor programmer team. The two groups were working on separate portions of OAIS,

orderwriting and software conversion respectively, but coordination of their progress, scheduling of computer time, and planning for the eventual combination of their two programs was not done.

LT Hopkins was a new project officer and many knowledgeable personnel had left the OAIS project, but that does not excuse her disregard for acceptable managerial behavior. Cooperation with LT Hopkins may have been more forthcoming if she had approached the functional managers in N471 first as a courtesy measure in regards to tasking their manpower or need for a schedule change. LT Hopkins did not have good interpersonal relationships with the functional managers. Her aggressive manner and "I want it done now" attitude contributed to the problem. Thus, she reduced her effectiveness and was not able to build a power base from which to launch the project. Assistance was available if she had only asked for it from her peers responsible for portions of functional management. In particular, CDR Hazel was an acknowledged functional expert on OAIS. The ability to build an expert power base by becoming an functional expert on the OAIS system was available to LT Hopkins. She did not make an effort to acquire the knowledge. If she had, in addition to building her expert power base, she would have been able to ask some intelligent questions throughout the OAIS development process. From this she may have been able to identify some of the problems prior to

implementation. The third power base, that of reward and punishment power, was not available to LT Hopkins due to the inadequate implementation of the matrix structure in the organization. Personnel affected by the two boss situation did not view tasking by LT Hopkins on the same level as tasking by their functional boss.

There are several factors which may have contributed to LT Hopkin's poor performance as a project officer. One factor was the mindset of the project officers in regard to the contractor. The mindset was, "We are paying big bucks for a quality product." Therefore, LT Hopkins did not have any indication that more involvement with the contractor was necessary than that of her predecessor. In the history of OAIS, the contractors had been taken at their word concerning all aspects of systems development and production. The contractors had not been wrong yet, which was one of the reasons that the OAIS reputation was good with both users and management. However, when LT Hopkins reported aboard, NMPC-47's project officer and the project manager for the contractor both left. This left just a handful of personnel familiar with OAIS functions and history involved with the project. Additionally, with OAIS documentation of poor quality, there were no references to turn to for assistance with problem solving. Lastly, previous development efforts and project managers did not have to contend with relationships with

training, systems administration or configuration management. These functions had not existed then. This may explain some of the lack of inclusion of Information Systems Support branch personnel in OAIS planning.

e. Pre-Implementation Problems

Pre-implementation activities typically involve the testing of the program, and training for users and operators. Testing of the program can be broken down into four types of testing. There is individual module testing or unit testing, to ensure that the internal workings of the module, the data structures, error handling routines, and the input and output parameters work properly. Next is integration testing. This is where all the individual modules are combined and tested for proper interfaces and data passing and their ability to work together. The third test is a system test. This test includes all the factors that make up a system, the hardware, software, peripheral equipment, people and procedures. This test is to ensure that all factors work together and perform their allocated function. The fourth test is validation of the system. Validation is a check to ensure that the customers' original requirements of what the system is supposed to do are fulfilled. The second major pre-implementation activity is user and operator training. User training consists of two parts--provision of formal user documentation on how the system works and "hands-on" training. "Hands-on" training

is the actual usage of the computer application. Users become familiar with both the computer itself and the application implemented on the computer. Users that are trained before implementation are much more likely to accept the new system and be less frustrated when things go wrong. Operator training is the training of the production control and scheduling personnel concerning new procedures for running batch jobs. Having operators familiar with new job control language, sequencing of jobs and indicators of smooth running operations is essential for successful implementation of the new application.

During preparation for the implementation of OAIS, some training and some testing were completed. User training was conducted in a conference room with the new user documentation. "Hands-on" training was not a viable option due to the lack of a training facility and test computer application. Individual testing was done on the modules. This testing was done in the evening due to the lack of a testing facility on the computer. Integration, system and validation testing did not take place. Before OAIS came up, there had never been a complete run-through of the whole application or system nor validation of what the application was supposed to do for the users.

f. Development Team

The programming team for development of the OAIS conversion and orderwriting module consisted of two groups.

One group was the contractors and their main job was conversion of the APSCOBOL code from version JK to version 1.7. The other group, made up of Navy Data Processing Technicians (DP's), was responsible for coding the newly designed orderwriting module. For the most part, the DP's were experienced programmers. There was a reason behind this integrated programming team. The reason was that maintenance of OAIS would be the Navy's responsibility once this version of OAIS was implemented. By having the DP's participate in the programming, they would gain some valuable experience with the language. Unfortunately, there was no coordination among the programming teams. For the most part each worked in isolation. The code the contractor's were converting would be interfacing with the new orderwriting module in several situations. The two would be passing data for order generation over an interface as well as creating batch reports. The lack of testing is unexcusable.

D. CASE STUDY THREE TEACHING NOTE

1. Questions

- What accounts for the failure of OAIS?
- What does CDR Griffin mean when he says "project office people always seem to forget the production portion of this business"?
- If you were LT Hopkins, what would you do when the new version is taken out of production?

2. Case Summary

This case study covers the timeframe immediately following the implementation of the new version of OAIS. The attitude and thoughts of NMPC-47 management are described. Reactions to the failure, and procedures to guard against problems happening in the future are addressed. A major manpower cut by OP-01 causes a change to the maintenance plans and contract management for OAIS.

3. Major Issues/Problems

- Project Management in a poorly implemented matrix structured organization.
- Lack of testing.
- Lack of concern for production issues.
- LT Hopkins's actions.

4. Case Analysis

a. Causes of OAIS failure

(1) Project Management. Russell Archibald states that the following six causes are the reasons for the poor performance on projects [Ref. 18:p. 10]:

- Poor understanding of the project manager job.
- Wrong type of person assigned as project manager.
- Excessive conflict between project and functional managers.
- No integrated planning and control.
- Rapidly changing and conflicting project priorities.
- Improperly organized and staffed project offices.

The first four of these causes apply to the OAIS failure. These four problems can be attributed to the poor introduction of the matrix structure for OAIS project management in NMPC-47. Without education of personnel involved in the change to a matrix structure and the subsequent change to procedures, and behaviors, there will be a poor understanding of the project manager job. Personnel tasked by LT Hopkins did not feel that her tasking was of equal importance as tasking from their functional managers. Being a project manager requires competence in working with people, force of personality and skills in group management [Ref. 19:p. 87]. By choosing a project manager who lacks these skills and relationships, the job is put in jeopardy of failing. Influencing functional managers and negotiating for the success of the project are a large part of the job. LT Hopkins lacked the interpersonal skills necessary to both motivate people and to facilitate project tasking. In particular for NMPC-47, by LT Hopkins lacking these skills, the problems inherent from the incomplete introduction of the matrix structure in the organization were magnified. These problems were evident in the excessive conflict between the functional managers and the project officer. LT Hopkins resorted to an aggressive style and by issuing absolute statements. The mandating of absolutes is a condition that Stanley Davis and Paul

Lawrence state is detrimental to working within the matrix structure.

The lack of integrated planning and control of the project development team is the underlying reason for the failure. This lack of integrated planning and control is particularly evident in the lack of coordination between the two different parts of the programming team. This lack of control led to a lack of integration and systems testing which ultimately caused OAIS to fail. The lack of integrative planning and control was also evidenced by not including Information Systems Support branch personnel in OAIS development planning. With the inclusion of all personnel whose expertise is needed to assist with the development of OAIS, a lot of problems could have been identified earlier in the project development.

(2) Lack of Testing. The primary cause, on the surface, of the OAIS failure, was the degraded systems performance caused by the converted code. The system slowed response time for user requests. This situation was allowed to continue for two days until user complaints were so numerous that top management could not ignore them. The users had become dependent on OAIS for production of their everyday work. They were unable to do their jobs for two days. When the new version of OAIS was taken down, there was another day of computer unavailability. A total of

three days were lost, an unnecessary consequence due to a lack of testing prior to implementation.

(3) Organization Inexperience. NMPC-47 is relatively new in the automated data processing business. In addition to project officer problems and poor matrix introduction to the organization, NMPC-47 is making mistakes because of inexperience. The contractors, who had implemented the original version of OAIS did not see the need for more testing of the application. NMPC-47 had not had to question the contractor previously and did not know any differently.

b. Lack of Concern for Production Issues

CDR Griffin's comment concerning how the project office people always seem to forget the production side of the business can be construed to indicate a lack of integration. CDR Griffin's comment acknowledges the management emphasis in NMPC-47, both past and present, which is on development. With over 300 users dependent on OAIS, maintaining production OAIS should have been of equal importance to enhancement of the application. To ensure proper addressing of production issues, N471 personnel should have been included in OAIS plans and decision making.

c. LT Hopkins Management Changes

LT Hopkins advocated two changes to the management of the OAIS application. She wanted OAIS modularized into smaller portions and test plans to be drawn

up for each screen, module, program and interface of OAIS. These two changes were good decisions.

Having OAIS broken down into smaller modules will facilitate testing, detection and correction of errors. Error detection and correction is made easier as the code that needs to be debugged is localized instead of being spread through out the program. Also by having a smaller portion of code to test, programs can be debugged more thoroughly [Ref. 20:p. 131]. Modularization also provides for the evolvability of the software [Ref. 11:p. 697]. If a change needs to be made, the module can be coded and inserted in the program with a minimum of effort and changes to other interfacing modules.

By mandating test plans for each screen, module, program and interface, there will be assurance that integrative and validation testing have been performed. Additionally, having the users involved in conducting the test plans will increase their confidence in the new system and assist with their training on changes contained in the new version.

One recommended change, that of having one group in control and responsible for the programming phase, was taken care of by the manpower cuts. This manpower cut laid the framework of the future for NMPC-47. NMPC-47 will now be dependent on contractors for development and maintenance of their computer applications. This change affected the

management of the entire life cycle, in particular adding additional costs for contractor resources to ensure the continued operation of OAIS. An additional recommendation is that if LT Hopkins continues her mode of operation of being the sole interface with the contractor, she should become more of a functional expert on OAIS and user requirements.

E. CASE STUDY FOUR TEACHING NOTE

1. Questions

- What are indicators of maturity in NMPC-47?
- What is the structure of the IS organization?
- Will the OAIS implementation be a success?

2. Case Summary

This case study describes the activities of NMPC-47 during the time period of May 1986 through May 1987. The primary activity taking place is the redevelopment of a new version of OAIS. Changes within the organization include transition from a development-oriented department to a production-oriented department with an emphasis on customer support. OAIS usage has increased. There are more terminals available than there are ports on the bus interface units connected to the local area network. OAIS users have become more comfortable with OAIS and in the process discovered unprotected data fields and ways to use OAIS information and screens that were not intended. Lessons learned from the implementation in May 1986 of OAIS

are applied to this implementation effort. A systems stress test is planned and executed. Test Plans are used for integration and validation tests.

3. Major Issues/Problems

- Maturity of OAIS.
- Centralization of computing resources.
- User sophistication.
- IS organization transition.
- Incorporation of lessons learned in May 86 implementation.
- Pre-implementation activities.

4. Case Analysis

a. Nolan's Stages of Growth

NMPC-47 displays characteristics of both the third and fourth stages of Nolan's Stages of Growth. The third stage is called Formalizing Control. Characteristics of this phase that NMPC-47 is exhibiting are growing pains towards maturity, some centralization of resources and equipment and an emphasis on processes instead of products. The growing pains and emphasis on processes is evidenced by the transition from a development-oriented department to a production-oriented department. A process of customer support has developed and it resulted from the consolidation of several separate products such as hardware repair, error research and report generation. The fourth stage is called Realignment and Integration of Processes. Characteristics of this stage that apply to NMPC-47 include user

sophistication and stability of operations. [Ref. 11:pp. 673-674]

(1) OAIS Maturity. The recognition of the usefulness of OAIS information has grown. Requests for access to OAIS are received from other commands. OAIS is not viewed as just facilitating the lives of assignment and placement officers within NMPC, but as being important to personnel planning activities external to NMPC. Recognition of the importance of OAIS information has personnel within NMPC competing for access to the application. There are more terminals than there are bus interface units on the local area network. Primary and secondary users are designated and specific ports are assigned to primary users. Competition for ports has caused port pirating. Considerable administrative time is spent solving the port pirate problems of users phoning the OAIS Help Desk.

Assignment and placement officers had relied on OAIS for quite some time. Now user top management is also depending on OAIS generated information to do their job. In recognition of the increasing reliance on OAIS, OAIS Help Desk personnel were required to inform NMPC-47 top management, and the Admiral in NMPC-4, whenever there was a major problem with OAIS. Also, CDR Griffin established the NMPDS Crisis Management Team. The make-up of the team, technical personnel from N471, was a statement supporting the production-orientation of the branch.

(2) Centralization of Resources. Computer operations are fairly stable. There are time and resources available to address production-oriented issues such as security, and customer support. A new security system is implemented, a test OAIS application is implemented and a dial-up capability for OAIS users out in the field is implemented.

The implementation of the new security system, in essence a shell surrounding the entire NMPDS application, is also evidence of planning for the future integration of the four applications within NMPDS. The need for a test application was evident during the previous implementation attempt. It is available now due to the availability of additional computer resources and a planning for the future of OAIS within the command. The dial-up capability is an enhancement to the customer support process. The customer support process is also enhanced with the consolidation of all user support functions into the OAIS Help Desk. Previously the separate products of error research, hardware repair and OAIS status information were handled by separate divisions within N471. With the consolidation of all user support resources into a central agency, the customer is served more efficiently and effectively.

(3) User Sophistication. OAIS users are very comfortable with the system. With this comfort comes

exploration (hacking) of the program. Unprotected data fields are discovered, screens are used for purposes for which they were not intended and information contained within the system is used for personal benefit. Examples of these unintentional uses are the Aviator's use of a screen for their internal phone list that was originally designed for the Submarine Department, and the review of personal information on doctors and lawyers before using their services.

With user sophistication and additional computer resources, application development has been enhanced. This has resulted in increased usage of the On-line Adhoc Information System (ODIS) and electronic mail applications. ODIS is a database system which users may access with a little training on boolean algebra. ODIS provides reports and information in a customized format, and a query capability. The current use of electronic mail is sporadic across the Distribution Division, but several departments have started relying on it for internal messages.

b. Information Systems Department Structure

There are three primary functions that are typically performed by a Information Systems department. These are development, maintenance and production control. Development is concerned with the analysis, design, programming, testing, documentation, project management and

implementation of new applications. Maintenance is concerned with the continued operation of current applications. Production control deals with the processing of daily operations, such as updates, report generation and output, which are necessary for the continued viability of the computer applications. Two support functions are also necessary within an Information Systems department: administrative and technical support. The administrative function deals with planning, budgeting and personnel. The technical support function addresses systems programming, communications control, system monitoring, technical assistance, user assistance and data processing standards. [Ref. 21:p. 90]

The Information Systems department, NMPC-47, transitions from a development-oriented to a production-oriented organization. As an information systems department matures, its operations become more important. This importance is due to the resources, in the form of personnel, equipment and software, which are needed for the continued support of computer systems in the organization. Once an application has been implemented and integrated into the operational routine of the organization, it cannot be discarded nor changed drastically due to user dependence. [Ref. 20:p. 46]

Prior to this transition, N470, the Information Systems Development branch, was responsible for management

of all three primary functions and parts of both support functions. This was accomplished through a matrix structure. Development was handled through contractors with liaison between the contractors and the Navy in the form of a project officer in N470. Maintenance was accomplished by the Application Programming Shop in N470, while the need for the maintenance was determined in N471 and N472. Project officers in N470 determined production control priorities while the personnel doing the production control work were located in N471. Refer to Figure 3 in Case Study Two.

This matrix management caused conflicts over work priorities, chain of command, and usage of personnel resources. Whenever there was a problem with production OAIS, LT Perkins at the OAIS Help Desk had to consult with LT Hopkins. In addition to wasting time, LT Hopkins was not fully aware of the impact of certain production problems on the users of OAIS. CDR Griffin and CDR Rice, branch heads for N471 and N470 respectively, also had conflicts over allocation of resources and development versus production priorities. With the priorities of the project management personnel taking precedence over those of production and technical support, both system readiness and the morale of personnel was low.

Once the transition of responsibility for production decisions was made from N470 to N471, the responsibility for the three primary functions and two

secondary functions was more evenly divided between the two departments. Refer to Figure 4 in Case Study Four. The Information Systems Development branch, N470, continued to have responsibility for application development. Their responsibility for maintenance was a temporary requirement until the new version of OAIS was implemented. The Information Systems Development branch, N470, had responsibility for only one support function, the administrative function. Systems Administration in N471 took over full responsibility for the production control function and some of the technical support functions such as systems programming, systems performance monitoring and configuration. Other technical support activities were handled by Configuration Management and the OAIS Help Desk. Configuration Management was responsible for technical assistance and data processing standards. The OAIS Help Desk, Training and personnel in N472 were responsible for user assistance.

Customer service is one of six critical areas needing management control to ensure continued efficiency and effectiveness of the computer systems [Ref. 20:p. 62]. Afterall, the computer system is for the users. The move of the training function from N470 to N471 and the consolidation of responsibility for all customer contact into the OAIS Help Desk facilitated the development of a total customer service concept. The main idea was to

provide one-stop shopping for the users. Prior to this consolidation, users had to call Error Research if they had a problem with officer orders, or call Systems Administration if there was a problem with the computer hardware or a printer, or call Production Control if there was problem with receipt of a report. CDR Griffin recognized the need of having one organization responsible for interface with the users. This consolidation ensured quicker and better service to the user. The OAIS Help Desk also assisted in achieving better communications with the users. Personnel at the OAIS Help Desk called each department's user representative to pass along important information concerning an OAIS problem or computer downtime.

A logbook to log all phone calls into the OAIS Help Desk was established. If a problem was called in concerning a hardware problem or report problem, a trouble report was sent to the appropriate part of N471 for correction. The time was logged and if feedback was not received at the OAIS Help Desk within a reasonable amount of time from the appropriate section of N471 responsible for the correction, follow-up action was taken. This audit trail ensured that a user's problem would not be overlooked. Additionally, the logbook provided a composite of user problems. From this consolidation it was possible to spot trends concerning problem prone hardware or frequency of errors.

The change of the organization focus to production issues and customer support brought about changes to the jobs that the Data Processing Technicians (DP's) had been performing in NMPC-47. Most DP's want to program. Most programmers have a job orientation towards systems development, even though the majority of the work is production and maintenance oriented [Ref. 22:p. 9]. The DP's experienced the maturity of the organization by seeing it progress from an organization where the focus was computers and programming to an organization where the user and user desires were of utmost importance. The DP's that worked on the OAIS Help Desk resented being put in the position of answering the phone and dealing with frustrated users. The glamourous positions in their eyes were those of Systems Administration and the Information Center in N470. One factor that may have assisted in facilitating this change in direction in the organization would have been clear-cut, mapped-out career paths for the DP's. Employees are motivated when there is a clearly-defined relation between performance, recognition and advancement [Ref. 23:p. 42]. Instead of having advancement and transfer up to the discretion of top management, with their decisions based upon past performance of personnel, designated career paths should have been established. When career paths are documented, personnel are motivated, recruited and trained

in accordance with their desires for promotion [Ref. 23:p. 41].

c. Pre-Implementation Activities

(1) Lessons Learned. One of the major problems identified with the implementation of OAIS in May 1986 was the lack of testing. In May 1986 there had been no integrative, system, nor validation testing conducted. All four types of testing were conducted for this implementation effort. One of the reasons for the lack of testing was lack of a test application. A test application was available for this implementation effort. Also, in the previous implementation, the programming team was a combination of Navy Data Processing Technicians and contractor personnel. Having two groups responsible for the programming required a lot of coordination and planning. For this implementation, all programming was done by the contractors. After the failure of the OAIS implementation in May 1986, LT Hopkins said she wanted test plans made up for every screen, program, and module of OAIS. These test plans were created by the contractor and reviewed by appropriate Navy personnel.

(2) Testing. A system stress test was scheduled for a Friday afternoon in February. An insufficient number of users participated for NMPC-47 to be sure how the system would react when a full load of users were using the system. Due to the Information Systems department being on the same level as the users in the

organization, CAPT Williams was able to intercede with the Admiral of NMPC-4 and his fellow department heads and get full user participation for a second systems stress test.

Individual module testing was done by the contractors. When the new project manager for the contractor, V. Hammer, came on-board, her first concern was for the lack of interface (an aspect of integrative testing) testing between OAIS and its interfacing systems. Interface testing became one of her priorities. The interface which she had no control over was the Order Production Module (OPM)-OAIS interface. The OPM was still under development at the time of interface testing. This status concerned both V. Hammer and LT Hopkins. Each took the matter to their immediate boss, but to no avail.

Validation testing utilizing the test plans and OAIS user representatives was scheduled for the six weeks prior to implementation. Validation testing was conducted every afternoon for these six weeks. Problems detected were prioritized either for correction prior to implementation or after implementation. The contractor had only the morning hours before each testing session to work on corrections to the problems. One of the problems identified with new system implementation is having inadequate time to test [Ref. 13:p. 123]. This was definitely the situation with the OAIS implementation. All the personnel involved with the testing, contractors, LT

Hopkins, LT Perkins, and CDR Hazel did not think OAIS was ready for implementation. There were too many problems which needed to be fixed prior to implementation in addition to the lack of testing of the OAIS interface with the OPM.

During the OAIS validation testing, more emphasis and personnel were added to the OPM project on both the Navy and contractor teams. The addition of extra people to a project has been shown to decrease productivity for a short time. The decreased productivity is due to time needed to train personnel, familiarize them with the project and the increased amount of time spent on communication between project members.

(3) Training. Training of users and operators of the computer systems is also an important part of pre-implementation. Training for the users was increased over the last implementation try. Users were kept informed of changes to OAIS by way of OAIS User Bulletins and their user representatives. An updated OAIS User Manual was distributed. The user representatives were the users that participated in the validation tests. Through their exposure to the new system, they would be able to assist other users in their departments. The OAIS Help Desk personnel also were trained by having access to the test system in the early morning hours before the contractors used it to correct the software problems discovered in the validation testing. Full scale, "hands-on" training of

users did not take place due to non-availability of the test application during normal working hours.

Operator training was planned to occur by having contractor personnel in Scheduling every night during the first few weeks of the new implementation. This would familiarize Scheduling personnel with the new procedures and potential problems.

(4) Method of Conversion. There are four methods by which an organization can convert to a new computer system: direct cutover, parallel conversion, staged conversion and pilot system. Direct cutover is when conversion takes place all at once. The old system is terminated and the new one is put in operation immediately. Direct cutover was the method chosen in the May 1986 OAIS implementation. There are risks to this method. The primary one being that if a major problem is discovered with the new system, it may cause some computer downtime for the organization. Advantages to this method include a lack of transition costs, and psychologically, users may try harder to work with the new application when there is nothing for them to fall back on. Transition costs are those costs in resources (personnel, computer time) incurred from running two systems at the same time. [Ref. 11:p. 737]

With parallel conversion, both the new and old systems are operated in parallel. The advantages to this method are that the old system is there to rely on in

case problems do develop with the new system. Disadvantages include the additional costs in resources of running and updating two systems. Staged conversion is essentially the replacement of the old system with the new system in a gradual manner. The advantage to this method is having the new capabilities of the new version while still retaining the flexibility to cope with any problems. The last method is by use of a pilot system. The new version is implemented in only one division within the organization. This minimizes the risk to the entire organization and also provides lessons learned to facilitate implementation in other parts of the organization. [Ref. 11:p. 736]

NMPC-47 chose parallel conversion for this implementation of OAIS. They possessed the additional computing capacity and willingness to take on the additional costs of resources to maintain both the old and new versions. There were several reasons for their choice of parallel conversion. OAIS users had a significant amount of work already completed in OAIS which would have had to be redone in the new system. It was determined that this would be detrimental to user service and user confidence. Also, in light of the implementation problems in May 1986, there would be a system to fall back on without any system downtime for the users. To ensure that users did not continue to use the old system unless they had previous work in OAIS JK, several of the screens were disabled.

(5) Conclusions. NMPC-47 improved their pre-implementation planning and activities. More thorough testing procedures were established and followed, covering all four types of testing necessary to inspect all aspects of new software. Users were involved with the testing through the use of test plans. More training of both users and operators was conducted. The ultimate state for training would include "hands-on" training for all the users, but this was unavailable to NMPC-47 due to the time and computer resources needed by the contractors to fix trouble reports discovered during testing. The decision concerning parallel conversion versus the direct cutover method was also a more cautious decision taking into account user workload. The area of testing remained the one problem of the pre-implementation activities. Insufficient time was allotted for the testing and subsequent fixing of trouble reports needing fixing prior to implementation. Additionally, problems still existed with the OAIS-OPM interface, which was the most crucial of all the OAIS interfaces because it was responsible for the output of the application. Insufficient concern was allotted to the OPM program and when it did become critical, more people were added to the project, slowing down productivity.

F. CASE STUDY FIVE TEACHING NOTE

1. Questions

- What caused the OAIS problems?
- What changes should have been planned?

2. Case Summary

This case describes the problems which occurred after the re-implementation of OAIS in May 1987. The majority of problems encountered were with the OAIS-Order Production Module (OPM) interface. Other problems associated with the new OAIS were accounting data problems, missing orders, incorrect orders and difficulties with the Communication Center. The OPM took the place of AUTONOM. The software changes this move necessitated were planned for. The administrative changes, which primarily affected the production portion of the department, were not planned for. These changes dealt with maintenance of magnetic tapes, increased demand for the letter sorter machine and inadequate reports for tracking of orders. Top management of NMPC-47 and the contractors got heavily involved in solving the problems.

3. Major issues/Problems

- Interface problems.
- Lack of planning.
- Top Management involvement.

4. Case Analysis

a. Interface Problems

On the surface, the majority of the problems with OAIS can be blamed on the interface between OAIS and the OPM. Problems with this interface were identified during execution of the test plan. The OPM failed all its tests, but was implemented anyway. The OPM was identified as a critical interface approximately three months before the implementation date. Neither the Navy nor the contractor project management team increased their effort until a few weeks before implementation. The additional personnel added to the project only slowed down productivity. This was due to the increased time needed to familiarize the personnel with the project and for communication among project members.

Developing the OPM was an accomplishment of the NMPC-47 long-term goal of being responsible for the entire order production process. The OPM did not just produce officer orders. It was also responsible for all the jobs previously accomplished by AUTONOM. AUTONOM had been responsible for producing the MPN Financial Management System (MFS) tape sent to Navy Finance Center, Cleveland with the accounting data and cost of each set of orders. AUTONOM had generated reports that assisted in the tracking of orders. AUTONOM had also placed OAIS information in the proper format for Naval messages or letters. It is obvious

from top management's decision to implement the OPM, even though it had failed the test plan, that they were unaware of all the possible repercussions of implementing the OPM.

Considering the six causes of poor performance on projects that Russell Archibald has compiled (see Case Study Three Teaching Note), the overriding general cause of the OAIS problems was a lack of integrated planning and control. Again, as in the previous implementation effort in May 1986, the improperly introduced matrix structure for project development is the root of the problems encountered. The project officer focus as on the software changes in OAIS, not on the changes which would be required of the entire organization to use the new OAIS. An information system is not just software. It also includes hardware, procedures, people and an applicable organization structure. With a system like OAIS that has far-reaching effects both on other organizations and on which users are heavily dependent, additional planning is needed. Additional planning in the form of establishing an interface with the OPM project officer from an early stage in the project and having an integrated project team consisting of development and production-oriented personnel was needed. These measures would have helped to prevent some of the problems.

b. Lack of Planning

An integrated project team could possibly have foreseen the following production-oriented problems: order

tracking and accounting, output verification, liaison with the Communication Center and condition of the letter sorter machine. The capability of tracking and accounting of orders could have been built into the reports generated for the OAIS Help Desk. Personnel performing verification of OPM output could have been trained and the new job descriptions could have been viewed with anticipation. An increase in duties to include liaison with the Communication Center could have been an increase in responsibility and morale for personnel at the OAIS Help Desk. With some advance planning, a good working relationship could have been established with the Communication Center prior to OAIS implementation. Having foreseen possible problems with the magnetic tapes, a standard run book procedure could have been established for Scheduling. A new letter sorter or supplementary maintenance of the old one could have been arranged in advance. A contingency plan could have been developed to provide for breakdowns.

NMPC-47 was faced with both computer-oriented problems and organization problems due to the implementation of OAIS. These problems were addressed and dealt with only in terms of expediency. The civil servants in N472 were delegated the job of verifying the orders that OAIS generated. This was an added burden for these personnel and decreased their morale. Since the letter sorter was down so often, enlisted personnel had to spend several hours a day

sorting letters by hand and preparing them for mailing. The job of liaison with the Communications Center was given to the OAIS Help Desk. If a problem was discovered with the daily magnetic tapes, the contractors had to be called to redo the tape or part of the tape. This took time away from fixing the software problems.

A problem with OAIS that was not caused due to a lack of testing were the enhancements made to OAIS JK that were not a part of OAIS 1.7. These were changes made by the Applications Programming Shop. These changes were not documented in the application documentation. Having them missing from the new version was again an example of a lack of integrated planning and control.

c. Top Management

Top management of both NMPC-47 and the contractor got involved to solve the crisis. Meetings were held three times a week with management and technical personnel. Top management assigned priorities and due dates for individual problems. LT Hopkins was taken out of the OAIS project. LT Perkins and CDR Hazel took control of day-to-day activities and correction of OAIS and OPM trouble reports. Top management became involved in the details of daily OAIS production and long range plans for correction of trouble reports. Their computer expertise contributed some much need direction to the OAIS project. This crisis paved the way for NMPC-47 management to realize that their

information systems did not exist in a vacuum. Information systems had become an integral part of the NMPC mission.

G. CASE STUDY SIX TEACHING NOTE

1. Questions

- How do you evaluate CAPT Hampton's changes?
- What are the signs of NMPC-47 maturity?
- How would you deal with the new contractors?

2. Case Summary

This case study addresses the timeframe of May 1987 through November 1987. NMPC-47 is slowly recovering from the problems generated by implementation of an inadequately tested application. The focus of the organization is on regaining user confidence and fixing production-oriented problems. A new contractor has just been awarded the maintenance contract for OAIS. A new department head makes changes in the organization structure and implements changes to administrative policies. The information systems organization and its users have matured. Users have an interest in daily activities and a vote on the priorities of application enhancements. A steering committee for NMPC-47 is formed to ensure compatibility of future plans for NMPDS and resource sharing. NMPC-47 has acquired sufficient functional expertise and computer savvy to be directing computer systems management with the contractors in an assistant role.

3. Major Issues/Problems

- Integration of information system into organization.
- Data is a resource.
- Maintenance.
- Documentation.
- Standards and Quality Assurance.
- User Responsibility.

4. Case Analysis

a. Nolan's Stages of Growth

NMPC-47's information systems and management are now in the beginning of the Data Resource Function stage, stage five. Characteristics of this stage exhibited by NMPC-47 are consideration of data as a resource, consideration of applications as valuable assets and integration of information systems into the organization. Also, managers are experienced in information systems and computing issues. [Ref. 11:p. 674]

(1) Data is a Resource. The establishment of the Configuration Control Board (CCB) is an indicator that NMPC-47 views data as a resource. This board is composed of functional managers, top management, technical experts and staff personnel from within NMPC-47. The focus of the CCB is on planning for the future, ensuring compatibility of data and requirements for the four applications within NMPDS and resource sharing. The CCB reviews any changes, both short and long term, prior to implementation.

The fact that applications are viewed as valuable assets in themselves is supported by two factors. One is the emphasis and time given to maintenance of OAIS. Placing an emphasis on maintenance expresses an evolutionary attitude concerning the importance of the information systems. Maintenance is the gradual upgrading and implementing of user and technical-oriented changes. This gradual process provides for economies of scale and long term efficiencies versus letting the system get outdated and having the large expense of developing from scratch [Ref. 20:p. 11]. "The updating of existing systems and capabilities, the balancing of stability with a degree of change can be an important measure of financial and operational success and of the maturity of the organization itself." [Ref. 20:p. 10]

In addition to maintenance, time is also needed to regain user confidence in OAIS. This confidence can be restored by a steady track record of implementing fixes to problems caused by the OPM and fixes to problems, such as PRD inconsistencies, that have existed for some time. By allocating all six contractor personnel to maintaining OAIS, this goal is possible. Additionally, allowing for maintenance time gave the new contractors time to understand the processes and programs of the OAIS application. This education will help facilitate the implementation of enhancements in the future. This time for

education is essential considering the poor condition of OAIS documentation. There is a cost to this emphasis on maintenance and re-establishing user confidence and that is application enhancements. Top management realized that with a new contractor, poor documentation, disappointed users and an unsteady OAIS foundation that the chances of problems with new enhancements, such as the problems experienced with the activity file, are likely. The benefits of taking this extra time will pay off in the future when the development of future enhancements takes less time and resources.

(2) Documenta ion. OAIS documentation had been of poor quality since the inception of the project in 1982. Problems caused by this poor quality of documentation had not been encountered previous to this time for several reasons. One, the same contractor that had developed the original documentation and program code, still had responsibility for the project. Two, the changes being made to OAIS were primarily centered aro.. d conversion of the software version and total redesign of certain interfaces such as the OPM and orderwriting m. ule. With a new contractor taking over the OAIS project there was unfamiliarity with the functions of the application as well as with the code. Adequately maintained documentation could have assisted the new contractor, instead of causing them problems.

Documentation of information processing can provide the following benefits: (1) content and format guide for

> documentation of data processing procedures, policies, practices and requirements; (2) complete record of an information processing system from analysis through implementation and maintenance; (3) data for simplifying and facilitating either conversion to new or upgraded hardware and or software or adoption of a new application; (4) communication medium for transfer of information. [Ref. 24:p. 121]

The new contractor's initial tasking was to correct all the problems with the OPM and production OAIS. This is where the documentation was needed, to try to understand the intent and content of the program. It became evident at this point that the documentation had also not been kept up-to-date. These problems with documentation, particularly the reporting and recordkeeping fall under the function of quality assurance.

(3) Standards and Quality Assurance. The second factor illustrating the organizations's view of the application as a valuable resource is the emphasis on standards. Standards for documentation, operating procedures and programs have existed since the establishment of NMPC-47. Configuration Management was responsible for making and distributing the policy on standards for organization and contractor use. Prior to this time period, however, the organization emphasis was on development. The extra time was not taken to ensure adherence to standards in the rush to get an application to the users. Once there was time, the problem seemed too hard and there were other pressing matters. It was not until NMPC-47 and the new contractors themselves experienced problems with the non-

documented software, that standards became the answer to their problems.

Standards are important for the following reasons: they are a basis of communications, so that all involved are talking the same language, they ensure compliance with policies and practices and they minimize the effects of changes [Ref. 24:p. 108]. Standards are a part of preventive management. Having a quality assurance function within the project structure in also preventive management.

> Quality assurance comprises a variety of tasks...: (1) application of technical methods, (2) conduct of formal technical reviews, (3) testing of software, (4) enforcement of standards, (5) control of change, (6) measurement, and (7) recordkeeping and reporting. [Ref. 12:p. 438]

Quality assurance is built into the functions of an information systems department by the establishment and documentation of control systems and procedures which are responsible for monitoring quality [Ref. 20:p. 151]. NMPC-47 implemented the quality assurance functions by having the OAIS Help Desk review and certify the work done by the contractor and by the adherence to standards. Prior to this period, the work of the contractor was not verified nor evaluated to ensure compliance with the standards. A change to production control procedures was implemented for quality assurance purposes. Production Control personnel were made responsible for reviewing the run books and program naming conventions to ensure their

feasibility and adherence to standards. This review was required prior to implementation. The review time added a few days onto the implementation of fixes, but in the long run would save time by having standardized procedures. NMPC-47 had a long way to go until quality assurance was a part of every application and program, but they have started a program to work towards that goal.

Quality assurance and utilization of standards minimize the effects of change on the application. Change is inevitable in a computer system. Changes are needed to correct errors, incorporate user requests for enhancements and to take advantage of technology advancements [Ref. 11:p. 605]. By minimizing the effects of change, the quality of maintainability is enhanced. Maintainability is defined by Roger Pressman as the ease with which software can be understood, corrected, adapted, and/or enhanced [Ref. 12:p. 531]. The concept of maintainability supports the design ion of an application as a valuable resource and that maintenance is part of an evolutionary approach to information systems planning.

(4) User Responsibility. The managers of NMPC-47 are now experienced veterans of information systems development and computing requirements. A lot of lessons were learned the hard way and at user expense, but the experience and lessons learned have been effective. This growth in expertise is evident in several ways:

establishment of the CCB, adherence to standards, use of requirements analysis for OPM fixes, and establishing a quality assurance review for contractor fixes. Another way the experience is evident is making the user more responsible for OAIS. The requirements of training prior to issuance of a password and mandatory attendance at user meetings were designed to make the users the driving force behind OAIS. By requiring the training of all users, NMPC-47 built user confidence [Ref. 209:p. 54]. This user education covered all aspects of the application and with this knowledge comes a sense of ownership, confidence, responsibility and interest.

b. Organization Changes

When Captain Hampton reported on-board, he made several changes to the organization structure of NMPC-47. He further refined NMPC-47 so that its branches were in alignment with the three functions and two support functions suggested for an information systems department. These three functions are development, maintenance and production. The two support functions are administrative and technical. A discussion of these areas is in the Case Study Four Teaching Note.

The customer support task within the technical support function was centralized further with the move of Order Support personnel in N472 to N471. The Information Systems Support branch, N471, now included all customer

oriented interfaces. The function of production control was broken out from under Systems Administration. This move was in recognition of its importance to the organization. With this change, problems which had existed for some time were able to reach top management. One of these problems involved report distribution and had brought on a Naval Audit investigation concerning wasted paper. Further, the lack of adherence to standards was brought out in the open and the CCB acted on this deficiency. An information systems policy and procedures branch was created. This branch contained portions of the technical and administrative support functions. Configuration Management and Data Administration were placed in this branch. This consolidation created a division responsible for controlling the assessing the applications in NMPDS and planning for their future.

c. New Contractors

NMPC-47 top management is impressed with the honesty and technically proficient explanations they receive from the new contractors, SYSCON. With the decision to put all six programmers to work fixing production problems, the active implementation of standards for configuration management and establishment of a quality assurance function, NMPC-47 is in an excellent position to ensure the quality of contractor work. Additionally, these efforts will assist in returning the OAIS project back to its good

reputation with the users. By having the CCB performing its function of ensuring compatibility and resource sharing for NMPDS and the contractor being required to explain the reasons behind both short and long term fixes, NMPC-47 has taken steps to guard against the problems caused by total reliance on a contractor.

There are two suggestions to ensure the continued viability of OAIS. One is that as the contractors progress through fixing production-oriented problems, NMPC-47 direct them and provide the time and money for updating the system documentation. This will assist with future implementation efforts and the move toward redesign of OAIS into a database oriented application. The second suggestion concerns project management. The OAIS project officer should acquire some functional expertise with OAIS and utilize an integrated project development team composed of production and maintenance technically proficient personnel for planning future development efforts.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

1. Research Question One

The conclusion, in regard to the first research question concerning what could have done to prevent the problems from occurring with OAIS, is still ambiguous. Prevention of problems like those experienced with OAIS can only occur through adherence to established standards and procedures for documentation, testing, and quality assurance. Following through with these activities throughout the life cycle of OAIS will facilitate the implementation of future changes and help ensure that the maintenance phase tasks are easier. This experience with OAIS and the subsequent analysis of this case study has assisted in the identification of possible causes of problems during information systems development. This knowledge will be of value in the future to help identify potential problem situations before they turn into full-blown problems.

The possible causes of problems pertaining to OAIS development include the following: (1) acceptance of poor quality documentation; (2) implementation of the prototype; (3) failure to adhere to standards; (4) lack of testing; and (5) lack of quality assurance activities. The problems

caused by the acceptance of poor quality documentation and implementation of the prototype had been put in motion by actions taken at the beginning of the OAIS life cycle.

Documentation is viewed by the majority of software developers as a peripheral activity. Yet, documentation is essential for the performance of maintenance activities in the future. The documentation received on the Officer Assignment Information System (OAIS) was of poor quality. In addition, the documentation suffered from a lack of updating as changes were made and maintenance activities performed. It was not until a new contract for OAIS maintenance was awarded in 1987 that the full effects of the poor quality of documentation were felt by NMPC-47. The contractors required extra time to understand the OAIS programs while trying to fix software trouble reports. This extra time took resources away from implementing user requested software enhancements.

Implementation of the prototype has been documented as a dangerous problem when utilizing the prototyping development methodology. This problem has been noted particularly in situations where users are unhappy with their present system. This was the case with NMPC. Problems had existed with the assignment process since the late 1970's. OAIS drastically improved the assignment process in comparison to the manual system. NMPC-47 yielded to user pressure and implemented the prototype. It is easy

to see why NMPC-47 made the decision to implement the prototype. Implementation of the prototype was a sensible public relations move. Users loved OAIS and the publicity OAIS received within the organization made those departments that were not on-line yet, want OAIS as soon as possible. This positive attitude would facilitate future implementation efforts. Additionally, as prototyping was on the leading edge of technology, there was little information concerning the pros and cons of prototype implementation to guide NMPC-47.

By implementing the prototype, NMPC-47 also set themselves up for efficiency and maintenance problems in the future. The prototype is developed rapidly with concern only for the output, not how the output is generated. There exists the possibility of compromises and inefficiencies in the implementation of the inner workings of the prototype. Though not explicitly stated as reasons for the problems with the OAIS versions implemented in 1986 and 1987, the inefficiencies in the development of the original prototype played a significant role.

2. Research Question Two

A second research question addresses explanations for problems encountered in OAIS implementation efforts. In addition to the impact of the implementation of the prototype mentioned above, the underlying factor which contributed to the problems encountered with both of the

OAIS implementation efforts in May 1986 and May 1987 was the project management function.

NMPC-47 managed application development with a project officer and a matrix structure for liaison between project management and functional management. The organization was not properly prepared to accept matrix management. Personnel must be educated and procedures and behaviors must be changed in order for the matrix to function properly. Most people are familiar with the "one person-one boss" tradition. Switching over to being responsible to two bosses, in this case a project manager and a functional manager, involves stress and uncertainty for the personnel concerned. The project management function worked successfully in the matrix structure during the initial development and deployment of OAIS. During this timeframe a production version of OAIS and involved functional management did not exist. For the implementation efforts in May 1986 and 1987, a production version of OAIS with approximately 330 users and functional management concerned for its continued operation did exist. This caused conflicts regarding the scheduling of manpower and computer resources.

A contributing factor to the implementation problems was a lack of integrated planning and control by the project manager for implementation of the new version. The project manager for OAIS was inexperienced in the software

development field. Her inexperience combined with a lack of managerial skills contributed to a lack of integrated planning and control. One manifestation of this lack of planning and control was a lack of testing prior to implementation. In 1986, there was no integration, validation nor systems test of the entire application. If these tests had been conducted prior to implementation, OAIS would not have been implemented. Another factor was a lack of planning for changes other than software changes caused by implementation of a new version of OAIS. In May 1987, NMPC-47 became responsible for the entire order production process, taking over responsibility for a variety of tasks dealing with verification and generation of output. These changes were not planned for and subsequently caused significant problems within the organization and among the users.

B. LIMITATIONS OF THE STUDY

This case study dealt with one organization within the U.S. government. NMPC is a Navy Headquarters command and the constraints under which it operates may not apply to a lower-echelon command. Additionally, the computer application was developed using a prototyping development methodology and a third generation software language. Factors and events deemed important using this methodology and software language many not apply to another type of methodology and software language. A further limitation

concerns the distribution of the computer application. OAIS was developed and utilized in one geographic location for a centralized group of users. Computer applications developed for distribution to several commands and spread over several geographic locations may not encounter the problems and events stated in this case.

Of particular note is the contrast between public (U.S. government) and private industry. The limitations imposed on the U.S. government include budget restrictions, full and open competition (when applicable) and bureaucratic practices for the approval of change. These practices take excessive amounts of time. Private industry does not function under the same type of limitations. If changes are required, they occur rapidly. If a particular product or company is preferred, private industry can choose it. The method or solution that a U.S. government agency may invoke is limited by the above-stated restrictions. The method to correct a situation such as that of NMPC may differ depending on whether it is a U.S. government agency or private industry.

C. FUTURE RESEARCH

In addition to documenting a situation where the leading edge of technology was an issue, this case also dealt with implementation of the computer application and its associated decisions and problems. The Computer Systems Management curriculum includes education on software

development principles and practices. There is little emphasis on the implementation side of the computer application. A recommended area for future research is an analysis of the feasibility of including implementation-oriented material within the curriculum.

D. RECOMMENDATIONS

1. Redesign of OAIS

In accordance with the problems encountered with prior OAIS implementation efforts, the following recommendations are suggested for NMPC's redesign of OAIS:

- Ensure complete and up-to-date documentation is available on OAIS programs and interfaces.
- Utilize development personnel and programmers who are experienced with the particular database package chosen.
- Plan for and follow through on extensive testing of all four types. Plan for testing and error correction to proceed at a normal workday (eight hours) pace of operations by allowing extra time for testing.
- Educate and train OAIS users thoroughly prior to implementation. Hands-on training is the most effective. If the users comprehend the changes being made, they will be more tolerant of any errors that may be detected once the application is implemented.
- Don't let the political pressures of a headquarters environment allow implementation of an application that is not ready. This short-term decision will only cause long-term problems and cost more in terms of resources in the long run.

2. Case Studies

Very few of the students who come to the Naval Postgraduate School have had any experience with development or implementation of computer applications. The basic

principles and procedures of software development are included in the curriculum. To a limited extent, some experience with software development is gained through experience with group projects. This experience is primarily in the field of microcomputer applications. Additional experience, whether real or the simulated experience of a case study, covering the areas of software development within the Department of Defense and in a mainframe/minicomputer environment are needed. This experience can assist students when they are confronted with a similar situation once they leave school. One of the primary figures, the project officer, in this case study was a Naval Postgraduate School graduate. To ensure that graduates of the Computer Systems Management curriculum do not make the same mistakes due to the lack of experience, there needs to be a stronger emphasis on change and implementation issues in Department of Defense organizations.

APPENDIX A

OAIS INTERFACES

OAIS interfaces with eight external applications and one internal (N47-managed) application. The internal computer system is the On-Line Distribution Information System (ODIS). ODIS is a database system and uses a Model 204 Data Base Management System (DBMS). OAIS provides daily or weekly updates of the personnel, billet and activity files to ODIS. ODIS does not pass any data back to OAIS.

The Officer Master File (OMF) is the primary repository of personnel data on all active-duty officers. The OMF is managed by NMPC-16. Every night an OMF change tape is run to update OAIS. Changes generated within OAIS during the day are provided via magnetic tape to update the OMF. Changes generated within OAIS include PRD changes, submarine/aviation pay changes, and order information.

The orderwriting system used until May 1987 was AUTONOM. AUTONOM was managed by NMPC-16. In addition to producing the officer orders for distribution to the fleet either through message or letter, AUTONOM also interfaced with the Officer Master File and the MPN Financial Management System (MFS).

When AUTONOM was run, it was sorted against the Officer Master File which verified order number, order modification

number, and detaching UIC information between OAIS and the OMF. If what was on OAIS did not correspond with the data on the OMF, the order became an AUTONOM Reject. Whether the orders were generated or rejected, AUTONOM provided OAIS with a transaction tape on a daily basis. This tape was used to update order status information with the date transmitted in the case of order generation, or in the case of order rejection, to pass the orders back up the automated chop chain for further work.

The MPN Financial Management System (MFS) tape was generated during AUTONOM processing. The MFS tape contained projected order costs for training and travel by individual SSN. This tape was sent to Naval Finance Center Cleveland on a daily basis by NMPC-16 and hard copy was provided to NMPC-7 for verification.

The Order Production Module (OPM) took the place of AUTONOM in May 1987. The OPM was managed by NMPC-47 through the Scheduling Shop. The OPM was originally designed for use with the Enlisted Assignment Information System, but was used with OAIS when a common order format was agreed upon between officer and enlisted distribution communities.

The Navy Manpower Data Accounting System (NMDAS) is managed by OP-01. Information concerning organizational manning totals, personnel and billet authorizations, and billet phasing dates is contained within NMDAS. Weekly changes to the database were provided via magnetic tape to

OAIS. These changes were of significant importance in assigning officers.

The Officer Fitness Report File (FITREP) is the responsibility of NMPC-3 and operated by NMPC-16. Condensed statistical fitness report information by individual Social Security Number (SSN) is contained in this system. Twice a month, updates from this system were provided to OAIS.

The Automated Detailing Instruction System (ADIS) was managed by NMPC-16. This system contained orderwriting and specific detailing instructions for each Navy activity. This information was updated in OAIS via magnetic tape twice a month.

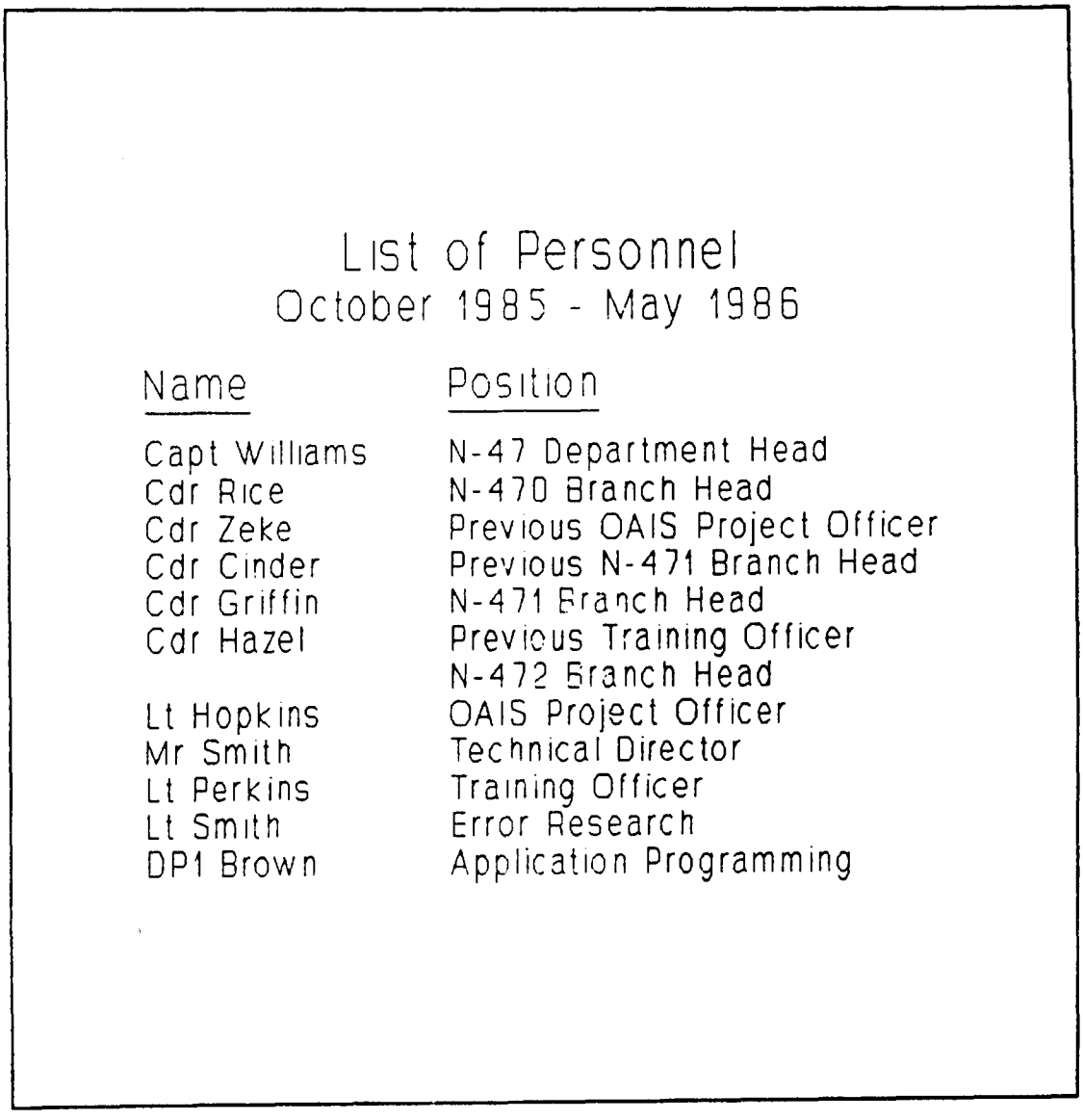
The Activity File was managed by the Enlisted Personnel Management Center (EPMAC). Information such as accountable Personnel Support Detachment Activities, Ship Deployment Dates, Command phone numbers and addresses were provided for each Naval activity. This information was updated once a month before May 1987 and once a week after May 1987.

The Officer Candidate Accounting and Reporting System (OCARS) was managed by NMPC-16. OCARS contained information on Officer Candidates which was needed for initiating their first set of orders. Information contained in this system was obtained from the Naval Recruiting Command or the U.S. Naval Academy. This information was updated in OAIS via magnetic tape once a month.

The Navy Information Training System (NITRAS) was the responsibility of the Chief of Naval Education and Training (CNET). Information pertaining to course schedules, convening dates and course quotas was contained on this system. Updates were provided to OAIS on a weekly basis.

APPENDIX B

TIMELINES AND PERSONNEL LISTS



List of Personnel
October 1985 - May 1986

Name	Position
Capt Williams	N-47 Department Head
Cdr Rice	N-470 Branch Head
Cdr Zeke	Previous OAIS Project Officer
Cdr Cinder	Previous N-471 Branch Head
Cdr Griffin	N-471 Branch Head
Cdr Hazel	Previous Training Officer N-472 Branch Head
Lt Hopkins	OAIS Project Officer
Mr Smith	Technical Director
Lt Perkins	Training Officer
Lt Smith	Error Research
DP1 Brown	Application Programming

Figure 7. List of Personnel, October 1985-May 1986

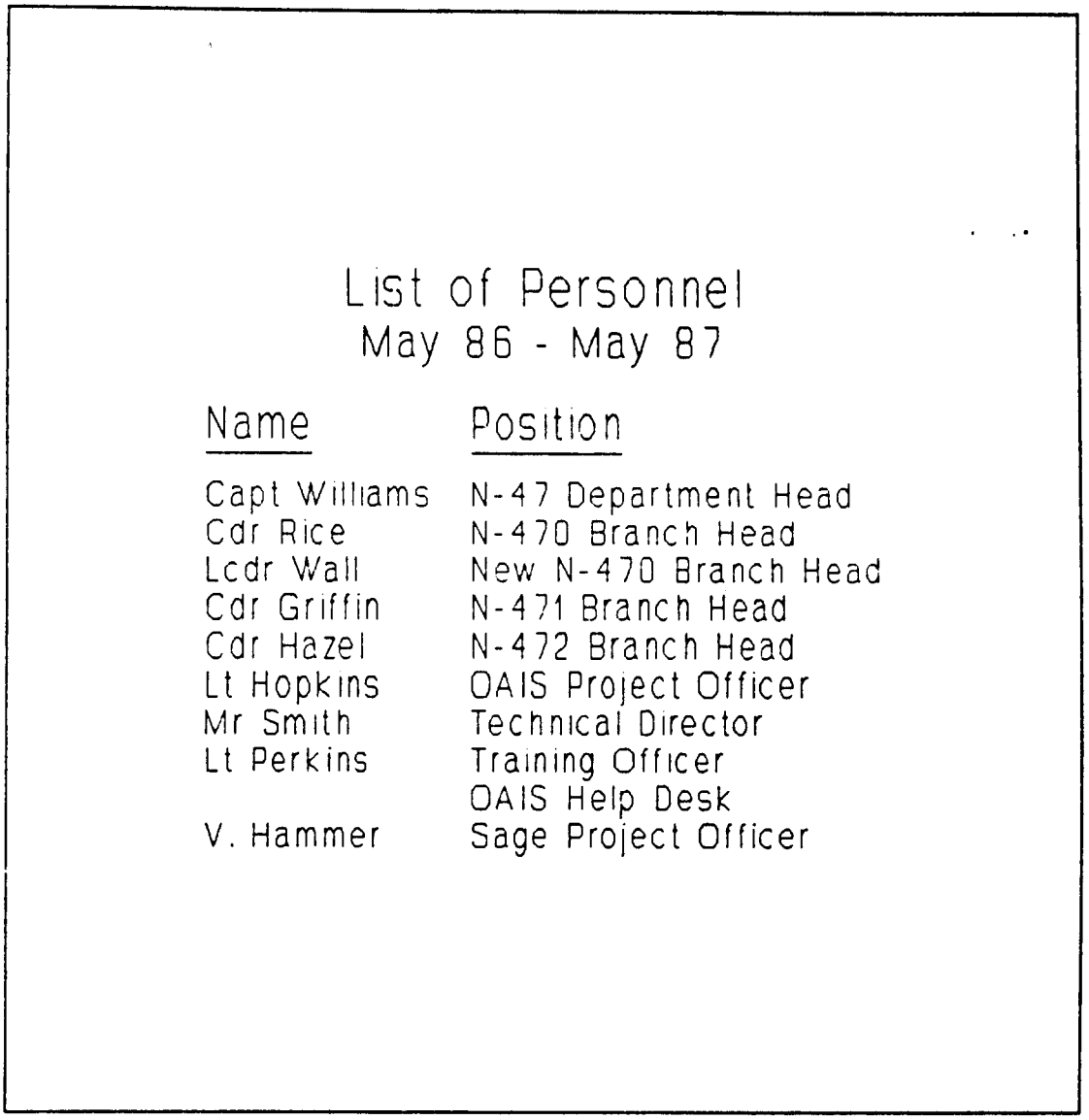


Figure 8. List of Personnel, May 1986-May 1987

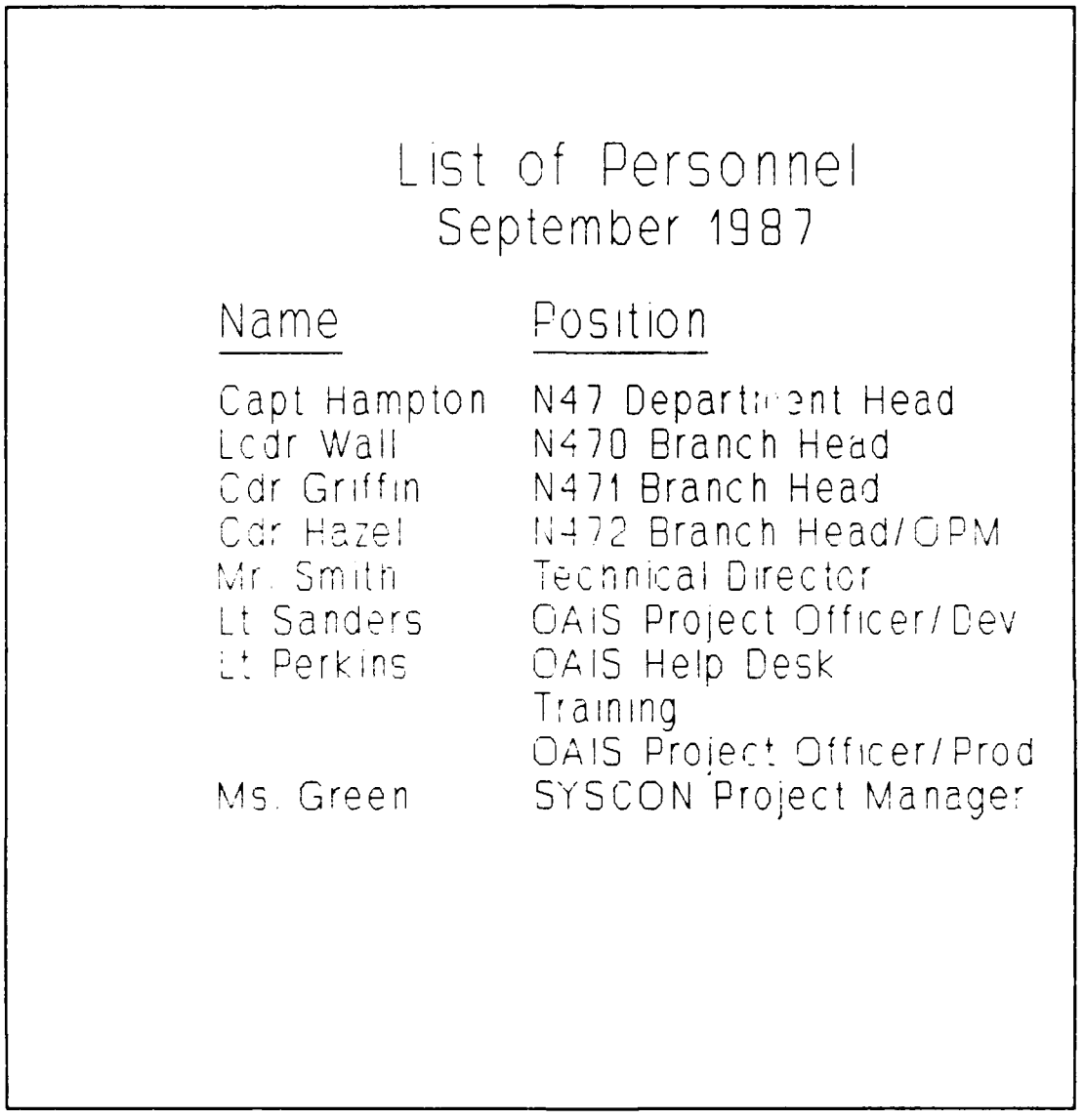


Figure 9. List of Personnel, September 1987

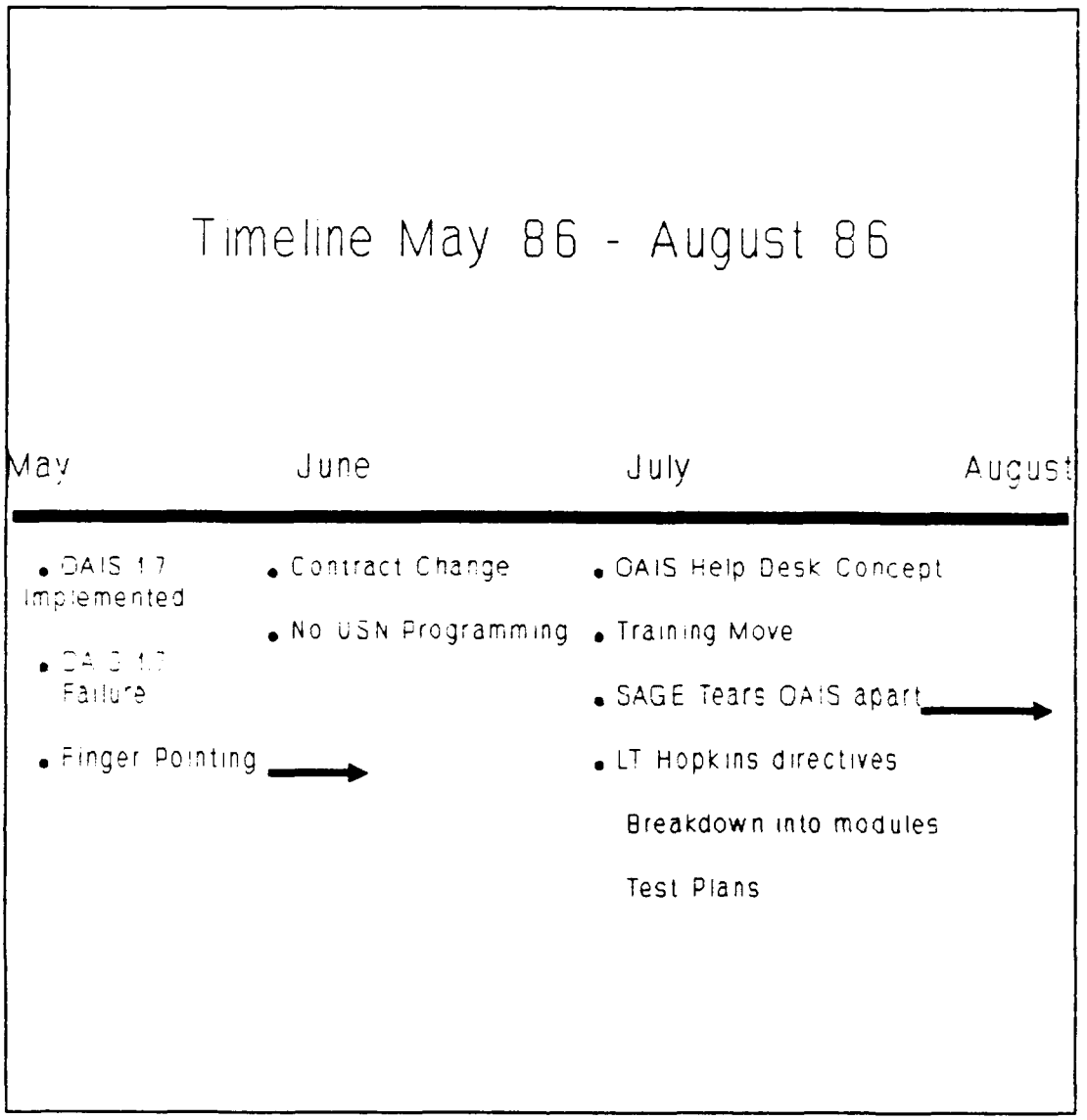


Figure 10. Timeline for May 1986-August 1986

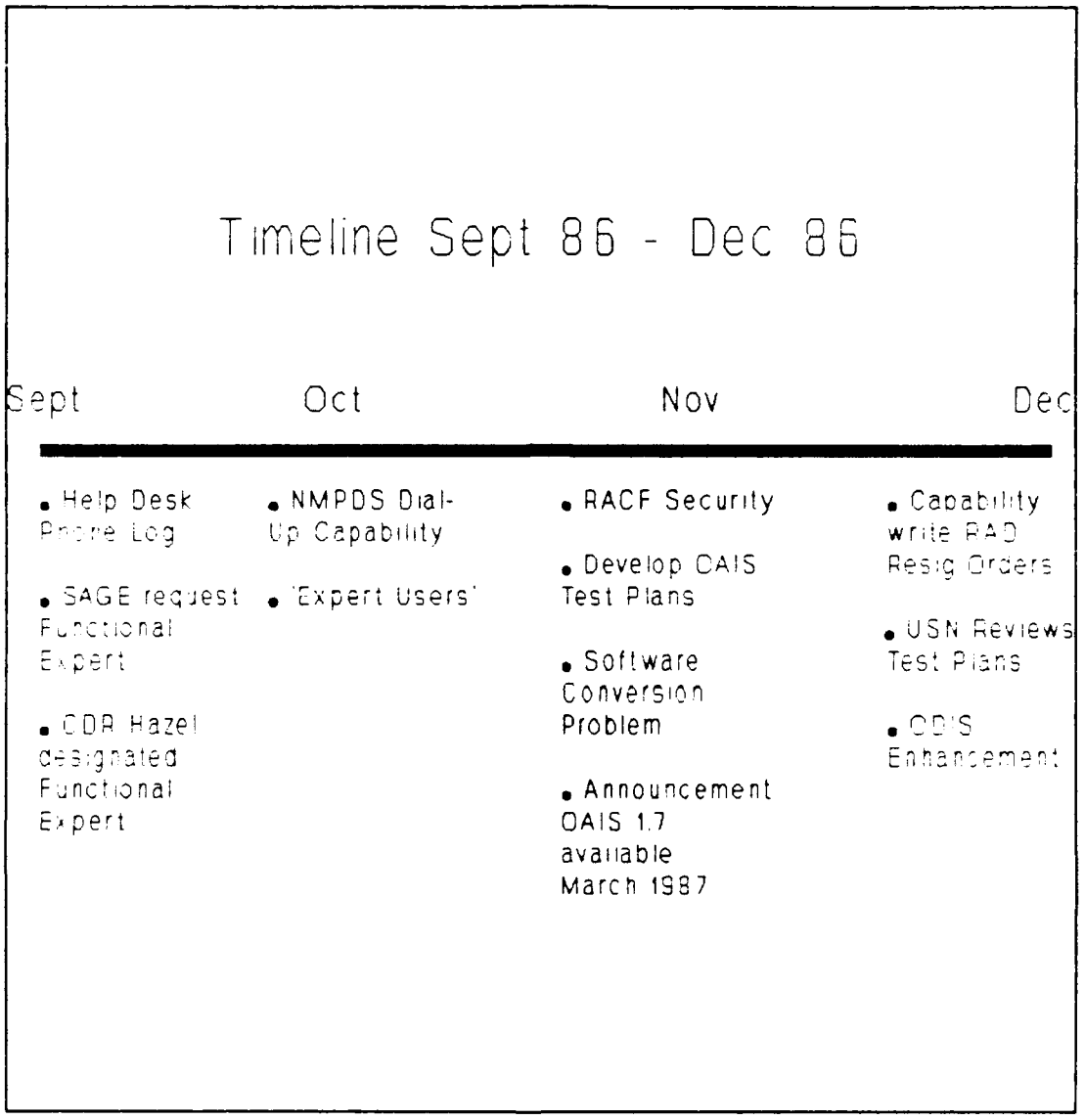


Figure 11. Timeline for September 1986-December 1986

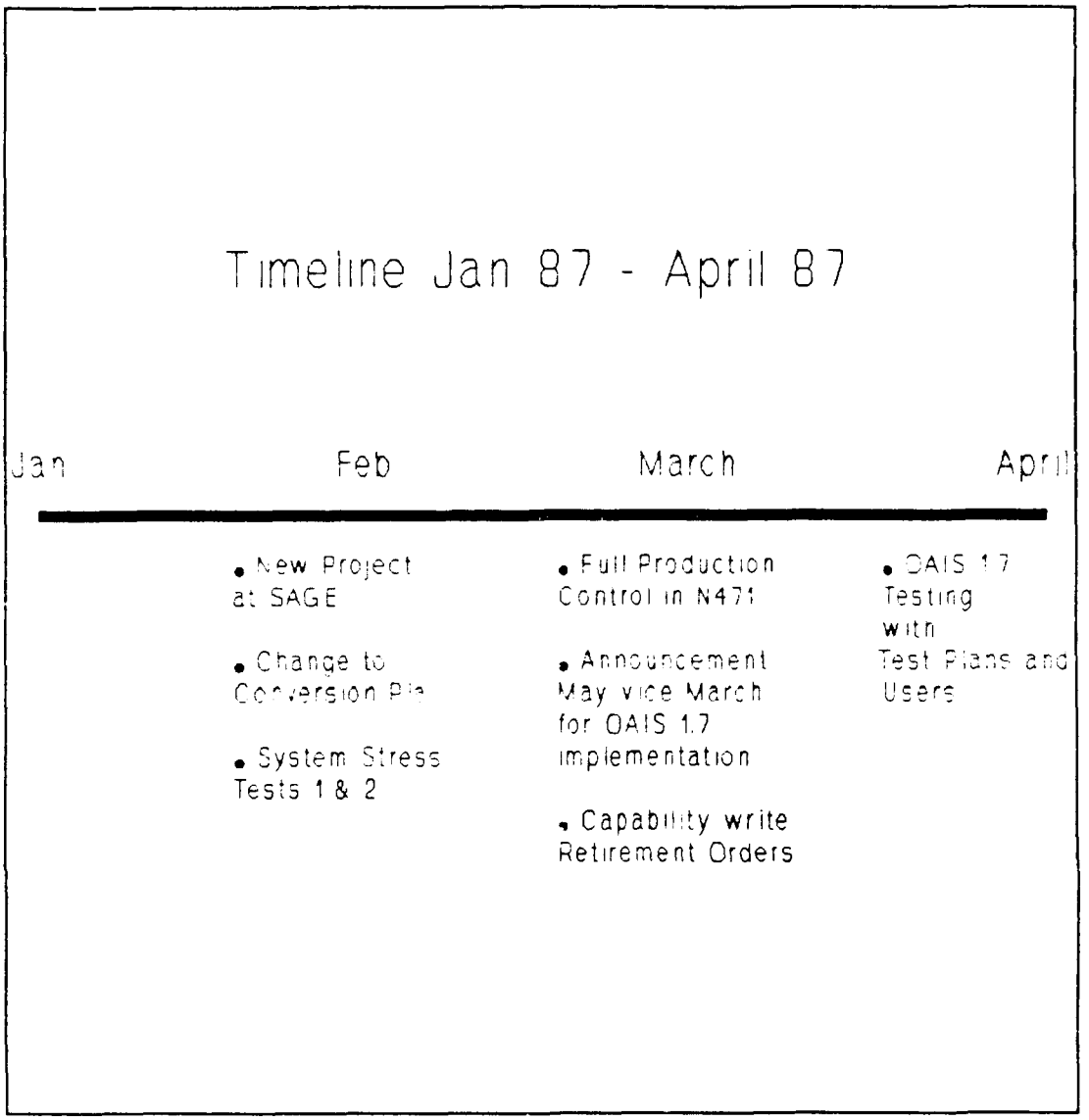


Figure 12. Timeline for January 1987-April 1987

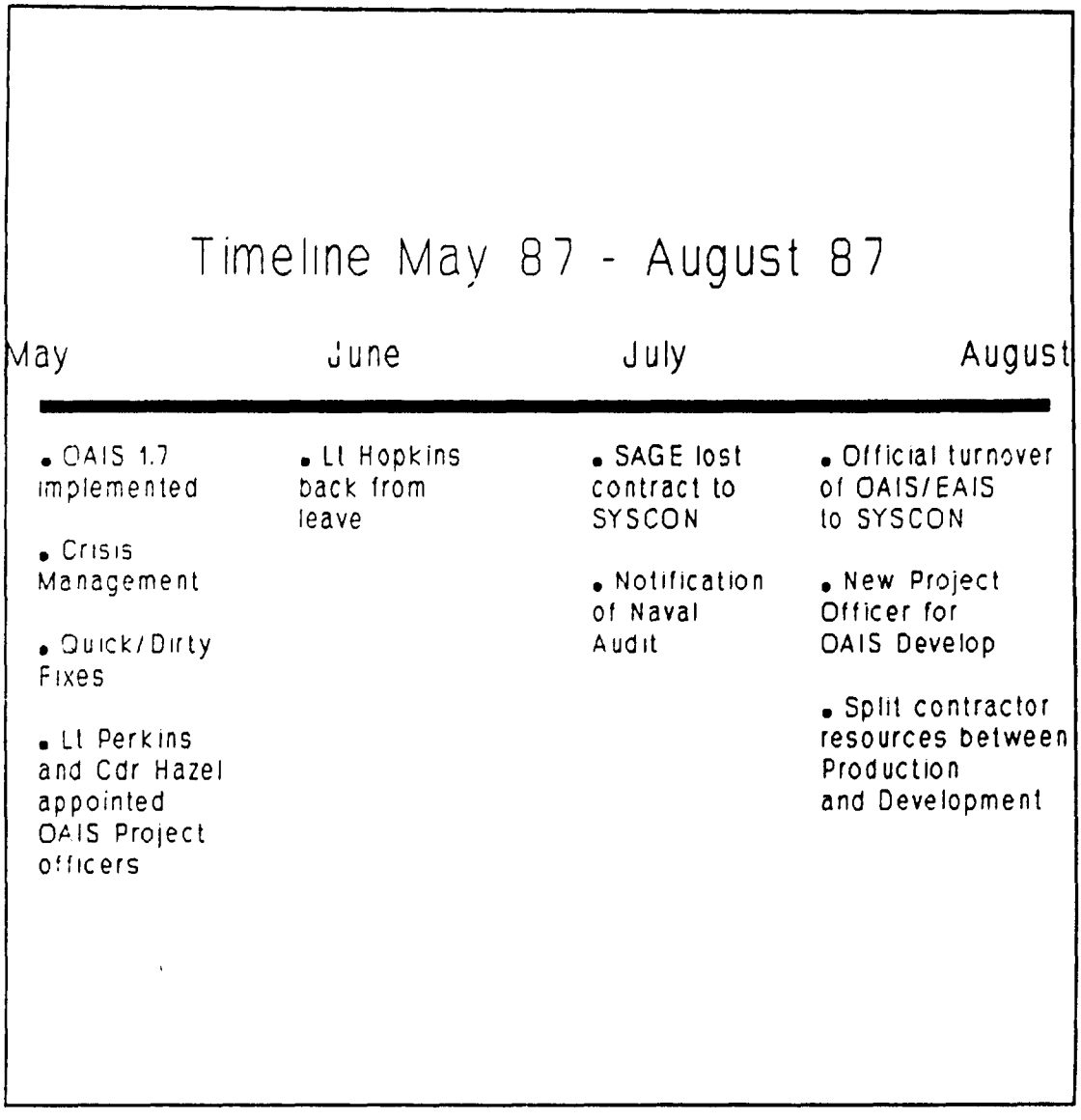


Figure 13. Timeline for May 1987-August 1987

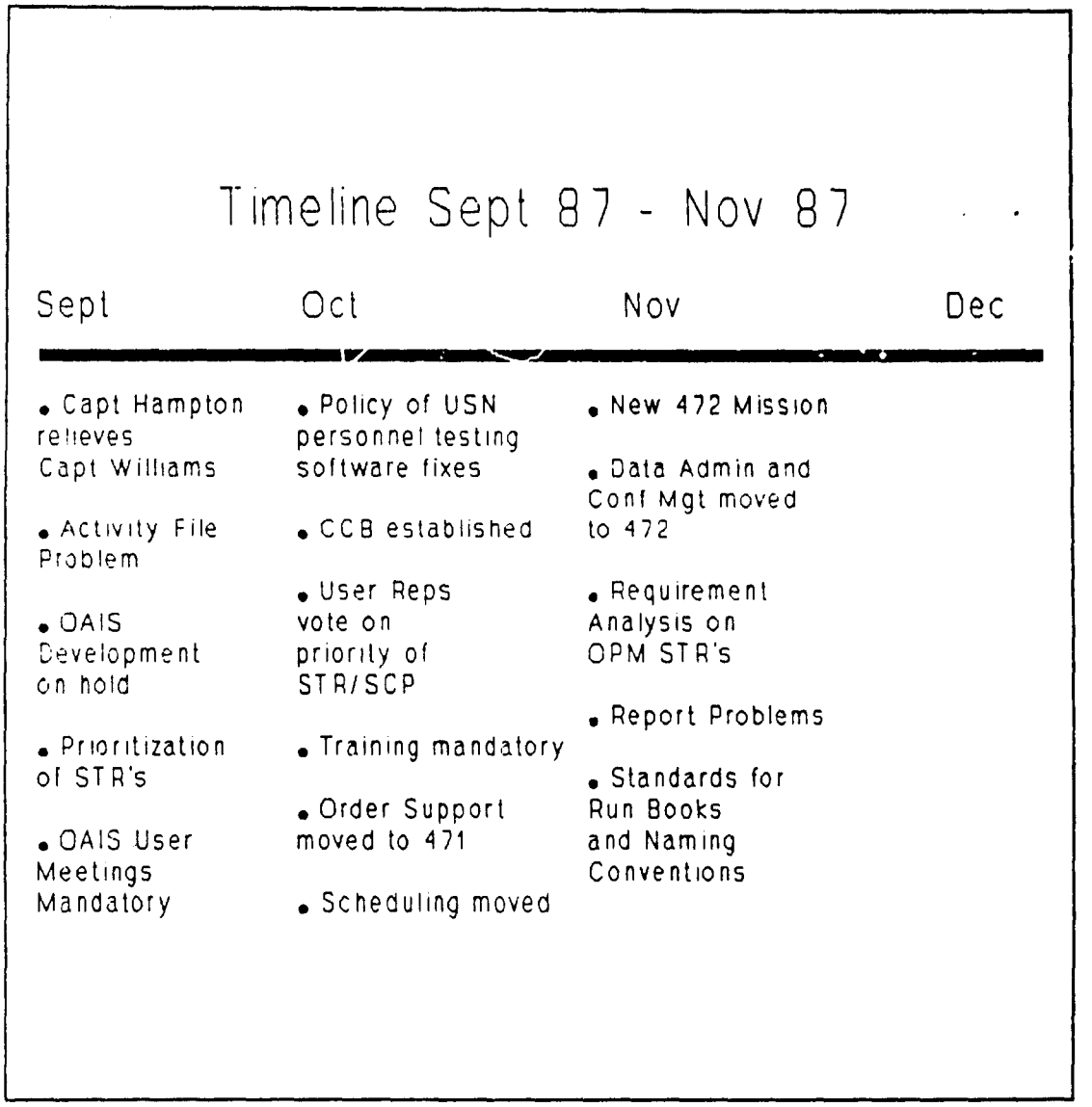


Figure 14. Timeline for September 1987-December 1987

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